

Ontario – Minnesota Boundary Waters Fisheries Atlas

Lake of the Woods
Rainy River
Rainy Lake
Namakan Lake
Sand Point Lake

April 2004





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by

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Preface

This latest revision of the Ontario-Minnesota Boundary Waters Fisheries Atlas presents fishery resource information and related socio-economic data from 1997–2002 surveys and monitoring programs within the boundary waters of Lake of the Woods, Rainy River, Rainy Lake, Namakan Lake, and Sand Point Lake. It was prepared by Ontario and Minnesota fisheries management professionals, working together as the Ontario–Minnesota Fisheries Committee.

The Ontario–Minnesota Boundary Waters Fisheries Atlas was first published in July 1984. Although it was later updated in October 1992 and July 1998, the primary purpose of this document has not changed. It continues to provide the necessary background information to allow development of options for managing these border water fisheries.

Acknowledgements

This Boundary Waters Fisheries Atlas was developed by the Ontario-Minnesota Fisheries Committee representing the Ontario Ministry of Natural Resources (OMNR) and the Minnesota Department of Natural Resources (MDNR). The editor was Tom Mosindy.

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Introduction

Potential Yield

The capability of a lake to produce a crop of fish is indicated by an index of productivity. This index (Morphoedaphic Index or MEI) is derived from two factors: the mean depth of the water body and the total dissolved solids in the water (Ryder 1965). Shallow lakes are more productive than deep lakes, and lakes with high levels of dissolved solids are more productive than those with low levels. Rainy Lake, which is deeper on average than Lake of the Woods, and has lower levels of dissolved solids, is therefore less productive.

The MEI is used to estimate the total annual potential fish production or yield for a given lake. This total potential fish yield estimate is synonymous with the maximum annual yield of all fish species that can be safely harvested from a water body. Guidelines to further partition this total potential fish yield estimate by species are based on data from a series of lakes that have withstood moderate to heavy commercial and angling pressure over time (OMNR 1982). The percentage of the total yield contributed by each species from these stable fisheries can be used to apportion the total potential yield into potential yields by species. For example, it has been found that percids (walleye *Sander vitreus*, sauger *Sander canadensis*, and yellow perch *Perca flavescens*), can comprise over one-third of the total potential fish yield in fish communities where they occur. This apportionment of the total potential yield may vary from lake to lake depending on the species and the type of fishery present, either angling and/or commercial. Species potential yields were derived for each water body by using the partitioning tables provided in Appendices 1 to 4.

Target Harvest

The potential yield is considered by biologists to be a "first order" estimator. Monitoring programs are employed to refine these estimates and to develop target harvests. The target is synonymous with the management harvest objective which reflects actual conditions of the stock, and is designed to achieve or maintain a healthy population with desired fishery characteristics. Annual harvests, up to the potential yield level for a species, are acceptable if the intent is to manage for maximum yields, and if assessment has indicated that the population is capable of sustaining harvests at this level. In other lakes, where potential yield has been exceeded, the refined data may indicate that stocks are being

overharvested and harvests should be reduced below potential yield, in order to rehabilitate the fishery. For some species, there exist healthy stocks that can sustain greater harvest. However, public consultation may support management for a quality or trophy fishery. This might entail keeping harvest at levels well below the potential yield level, in order to produce greater numbers of large fish. Therefore, the target harvest level or management objective would reflect this intent.

In fisheries where the stock of any one or more species has been seriously debilitated, such as walleye in the North Arm of Rainy Lake, it is often necessary to set target harvests below potential yield for two reasons. One is that the stock is simply not present. Another is to assist the remaining stock to regain its former abundance, and to produce at its original potential yield level. In other cases, such as for northern pike *Esox lucius* in the North Arm of Rainy Lake, habitat and fish community conditions may favour a species to produce at levels above its theoretical potential. If a stock demonstrates this, then targets may be set at higher levels to reflect this change in productive potential. However, there is increasing risk associated with managing at or near maximum potential yield levels, especially in multi-use fisheries (e.g. subsistence, commercial, angling), and for species which are subject to wide natural fluctuations in abundance (e.g. percids). In general, fish populations go through a continuum of change as harvest increases. Initially, an unharvested population of fish tends to be dominated by relatively old individuals, with slow growth and a low rate of recruitment. As harvest begins, and increases, there is a trend to decreasing relative abundance of the older fish, with a corresponding increase in abundance of young fish. The age/size structure shifts from a broad range of ages and sizes to a narrow range dominated by younger and smaller fish. Growth rates tend to increase, as does recruitment. Concurrently, the age of maturity will decrease. Absolute abundance will increase initially, though biomass will remain constant (there are more small fish and fewer large fish). As exploitation increases further, absolute abundance of individual fish, and biomass will both decline. These are normal responses to exploitation. At some point along this continuum of change, the fish population is considered to be under stress.

The point at which the population is considered stressed is related to the goals of the management agency. If a fish population is to be managed to provide a trophy fishery, the fish population could be considered stressed as soon as the older, larger individuals disappear from the population. If a fishery is to be managed for a quantity fishery, with the greatest possible number of individuals

and high catch rates, a fish population could be considered to be stressed as abundance and biomass both decline. Note that it is not possible to manage a fishery to provide high catch rates of trophy-sized individuals.

Assessment Methods

Assessment programs are conducted by the management agencies to determine the current status of fish populations and their associated fisheries. Standardized surveys are designed to monitor changes in biological characteristics of fish populations and in fishing activity, using a variety of analytical techniques. Data collected are analyzed to identify trends in: abundance; age and size structure of a fish population; mean age of the fish caught; and the growth and maturity rates, which are valuable indicators of the health of a fish population.

Management agencies survey fish populations on a regular basis with standardized fishing gear, or index (test) nets. These surveys sample fish across a broader range of sizes than those taken by commercial nets or anglers.

Creel surveys are regularly conducted throughout the year to provide information on angling fisheries within the border waters area. Angling effort and harvest by species, age and size composition of the catch, and angling success rates (catch-per-unit effort and harvest-per-unit effort) are estimated from survey data. In addition, user group characteristics such as the residency and visitor type of anglers are recorded.

Commercial fisheries on the Ontario portions of Lake of the Woods, Rainy, Namakan, and Sand Point lakes are regulated by quotas and limitations on fishing gear (gill nets or trap nets). Fisheries are monitored by monthly reporting of harvest along with records of sales to domestic and business markets in Canada and the United States. Some commercial fish species are sampled for length, weight, and age to assess changes in stock status over time, and to evaluate quota levels. Changes in fishing success (catch-per-unit-effort or CUE) for some species and gear types can be used to detect trends in population abundance.

In the absence of more recent information, subsistence harvest estimates for Lake of the Woods, Ontario were based on an annual per capita consumption rate of 35 kg (77 lbs) of fish per First Nations resident. Hough *et al.* (1982) derived this estimate from questionnaires and interviews with First Nations residents in communities around Lake of the Woods. Subsistence harvest estimates by sector were adjusted to reflect the current number (2001 census) of First Nations residents living

within each sector, fish species consumption preferences, and fish community composition within specific sectors. A subsistence harvest estimate of 18 kg (40 lbs) of fish per capita on reserve was used on Rainy Lake (Darryl McLeod, OMNR Fort Frances, pers. comm.)

Ontario

The Lake of the Woods area manager in the Kenora District office is responsible for fisheries management of all Ontario waters of Lake of the Woods. Rainy River, Rainy Lake, Namakan, and Sand Point lakes are the responsibility of the Rainy River/Manitou and Rainy Lake area managers and their teams in the Fort Frances District office. Assessment activities on Rainy River, Rainy Lake, and east are conducted by Fort Frances District staff. Kenora District staff conduct assessment projects on Lake of the Woods with partnership groups through the Community Fisheries Involvement Program (CFIP). Fisheries assessment on Lake of the Woods continues to be the primary function of the Lake of the Woods Fisheries Assessment Unit (LWFAU), which is based in Kenora but is part of the Northwest Science and Information office in Thunder Bay.

LWFAU activities on Lake of the Woods are part of a long-term monitoring program to provide fisheries information on this lake for local management, and for comparison with similar lake types and fish communities throughout the province. A provincial "core data" program dictates the type of standardized programs and frequency of sampling.

The Ontario waters of Lake of the Woods have been divided into seven sectors for assessment purposes, based on observed differences in physical and chemical parameters, fish community composition, and user group patterns. The LWFAU monitors various portions or sectors of the lake on a two-year rotational basis as follows: North and Central sectors in 1997/98; Whitefish and Sabaskong bays in 1999/2000; and South Sectors 5 and 6 in 2001/02.

Assessment programs include index gill netting; fall walleye index netting (FWIN; Morgan 2002); spring littoral index netting (SLIN; Hicks 1999) to assess lake trout *Salvelinus namaycush* populations; trap netting to assess important spawning populations during spring and fall, commercial fish sampling to monitor commercial harvest, and shoreline seining for forage and young-of-the-year fish. Lake-wide creel surveys were conducted in 1999 and 2002 to monitor openwater angling. Winter creels were conducted on Whitefish Bay in 1997, 1999, 2000, and 2003, on Sabaskong Bay in 1997, 1999, 2000, 2001, and 2002, and in the North/Central sectors in

2001 and 2002. Annual programs to monitor the aquatic environment include water quality sampling, physical habitat mapping, and surveys to assess benthic and zooplankton/phytoplankton communities.

Assessment activities on the Ontario waters of Rainy Lake are similar, but less frequent, than those conducted in Minnesota. These consist of fall walleye index netting on one of three basins on an annual rotation (i.e. North Arm in 1997 and 2002, South Arm in 1999, and Redgut Bay in 1998), and openwater creel surveys for two consecutive years in every five (i.e. North Arm in 2002, South Arm and Redgut Bay in 2001). Sampling to assess the commercial harvest of whitefish *Coregonus clupeaformis* was conducted in 1997 and 1998, along with spring trap netting and tagging to monitor North Arm walleye, and northern pike spawning populations in 1997. Beginning in 2002, an intensive investigation of the status of lake sturgeon *Acipenser fulvescens* populations in the South Arm of Rainy Lake was initiated, involving fish tagging and radio telemetry. This cooperative study is being lead by Voyageurs National Park (VNP) and the United States Geological Survey (USGS), with financial and technical assistance from the Ontario Ministry of Natural Resources (OMNR) and the Minnesota Department of Natural Resources (MDNR), and will run through 2005. A genetics study of lake sturgeon and northern pike was also initiated in 2003 to help evaluate stock discreteness and variability across the boundary waters area.

Assessments activities on the Ontario waters of Namakan and Sand Point lakes consist of fall walleye index netting once every four years (i.e. Namakan and Sand Point lakes in 2002), and an openwater creel survey once every five years beginning in 1993 (i.e. Namakan and Sand Point lakes in 1998). Additional studies are being conducted as part of a more intensive monitoring program to evaluate water level effects after the 2000 International Joint Commission (IJC) rule curve changes.

Minnesota

Area Fisheries managers and staff are located in Baudette and International Falls, Minnesota. The Baudette station is responsible for fisheries management on the Minnesota portion of Lake of the Woods and the lower reach of the Rainy River, while Rainy, Namakan, and Sand Point lakes, and the upper Rainy River are under the jurisdiction of the International Falls office. Management of border waters constitutes the primary responsibility of personnel at each of these stations.

Assessment activities in Minnesota are governed by the Large Lake Sampling Guide

methodology described by Wingate and Schupp (1983). Sampling consists, minimally, of the following programs: young-of-the-year (YOY walleye, sauger, and yellow perch) and forage abundance assessment with seines and/or trawls during July and August; and fall gill net assessment for walleye, sauger, and yellow perch populations during September. The Baudette office also conducts: a spring electrofishing assessment for spawning walleye at Long Sault Rapids near Birchdale on the Rainy River; lake sturgeon tagging and assessment in Four Mile Bay, the Inside Channel and Rainy River during the spring; and northern pike spawning assessment after ice-out in tributary streams on the south shore of Lake of the Woods and Rainy River. Rainy River fish populations were assessed in 1997 and 2000, a frequency of once every three years. The International Falls office also conducts spring electrofishing assessments for walleye and smallmouth bass *Micropterus dolomieu*, fall electrofishing for walleye, and spring assessments for black crappie *Pomoxis nigromaculatus* and rainbow smelt *Osmerus mordax*.

Creel surveys are conducted annually on Lake of the Woods and Rainy Lake during the summer and on the Rainy River during spring. The fall Rainy River fishery is assessed two out of six years, with the most recent creel survey conducted in 1997. The summer Rainy River fishery was surveyed in 2001 and 2002. The Northwest Angle based fishery, which is scheduled to be on a two-year out of six-year rotation, was surveyed only during the summer of 2002. The Lake of the Woods winter fishery was sampled annually from the winter of 1997–98 through the winter of 2002–03. The spring northern pike fishery was assessed from 1997 through 1998 as part of the experimental northern pike regulation evaluation. The Rainy Lake winter fishery was sampled during the winter of 2002–2003.

The Namakan Lake and Sand Point Lake fisheries have been investigated numerous times since the first population assessments were conducted in 1970. Since 1983, annual assessment netting in the Minnesota waters has been done in late September, and has followed Minnesota's large walleye lake sampling program guidelines. Creel surveys were conducted for the Minnesota fishery in 1977–78 and from 1983 to 1990. Angler creel surveys are done on the Minnesota side of Namakan Reservoir on a two out of six-year rotation. The most recent creel survey was completed in 1999. Another creel survey is scheduled to begin in May of 2004.

Distribution of Fish Stocks

Movement patterns are usually determined by releasing tagged fish and noting the location of their reported recapture. The locations of fish which have been surgically implanted with small radio transmitters can also be tracked on a regular basis over time, in order to determine seasonal movement patterns and to identify critical habitat, e.g. spawning grounds. In addition, information from tagged fish can be used to determine the impacts of angling and commercial harvest on populations (such as exploitation rates), to evaluate the effectiveness of existing or proposed management actions, to set appropriate management targets, and to design future assessment programs. Monitoring fish movement patterns can assist Ontario and Minnesota in determining whether stocks are shared. A stock of fish is a group that spawn together, but not with other groups of fish of the same species. A stock of fish which is shared between jurisdictions is a stock which spends time in the waters of each jurisdiction. A number of factors exist which can make interpretation of fish movement information difficult, especially when it is being used for the purposes of partitioning stocks between jurisdictions. Attempts to quantify movement patterns based on the frequency of tag recaptures can be strongly biased by the amount and type of fishing pressure exerted within a geographic area. For example, a high rate of tag returns from a specific area may not necessarily indicate significant fish movement. Instead, it could reflect greater fishing pressure within a concentrated area if angling is not evenly distributed. Fish with dorsal tags affixed with fishing line or wire may be more vulnerable to entanglement in commercial gill nets than those without tags. Other factors such as tag loss and rates at which tag recaptures are reported by various user groups can further complicate interpretations. Further study of fish movements and stock discreteness is recommended.

Lake of the Woods/ Rainy River

Studies to determine movement patterns have been conducted on walleye, lake sturgeon, and smallmouth bass. **Walleye** stocks have been tagged at six different spawning sites along the international boundary including:

- Rainy River at Birchdale;
- Four Mile Bay at the mouth of the Rainy River;
- Elm Point, a southerly extension in Minnesota

of Buffalo Point, Manitoba;

- Flag Island/Sugar Point area near the Northwest Angle;
- North Island, Ontario off the southwest shore of the Aulneau Peninsula; and
- Bear Island, Ontario north of Big Island (Figures 1 and 2).

Results from these tagging studies indicate that most walleye were recaptured within 10 to 15 km (6–9 miles) of their spawning areas, but that a significant portion of the walleye spawning at Bear Island, North Island, Flag Island, Rainy River, and Elm Point dispersed across jurisdictional and management sector boundaries. After spawning, these stocks mixed with other spawning stocks and formed multiple spawning stock fisheries. The Ontario–Minnesota Fisheries Committee has agreed that even though walleye stocks may be shared between jurisdictions, the management of fish within the waters of a jurisdiction is the prerogative of that jurisdiction.

Lake sturgeon movements were monitored in the south end of Lake of the Woods and the Rainy River based on 26 adult lake sturgeon that were surgically implanted with radio transmitters during 1987–90 (Figure 3). Results from this study suggested that two distinct groups of lake sturgeon inhabited this area: a river population, and a lake population. Those classed as “river” fish spent the winter in the lower Rainy River, downstream of Long Sault, and appeared to spawn earlier in the spring than the lake population. “Lake” fish did not enter the river during the year except to spawn. Both populations used the same spawning grounds at Long Sault, Manitou Rapids, and just below International Falls on the Rainy River, in addition to a number of sites upstream on major tributaries such as the Big Fork and Little Fork rivers in Minnesota. Although fish from both populations were found around the mouth of the Rainy River and throughout the Big Traverse during the spring, summer and early fall, it was the lake population that overwintered in Lake of the Woods. Since fish of both populations made extensive seasonal movements throughout both Ontario and Minnesota waters of Lake of the Woods and the Rainy River, including common spawning sites on the Rainy River, this stock was considered to be shared between the two jurisdictions. Potential yields were estimated using 0.04 kg per hectare (Brousseau 1987) since these lake sturgeon populations are still recovering from overexploitation. The amount of surface area inhabited by sturgeon in Ontario and Minnesota was defined as those waters less than 12.2 m (40 ft) deep and accessible to or known to be frequented by this stock.

Smallmouth Bass movements were monitored

Walleye

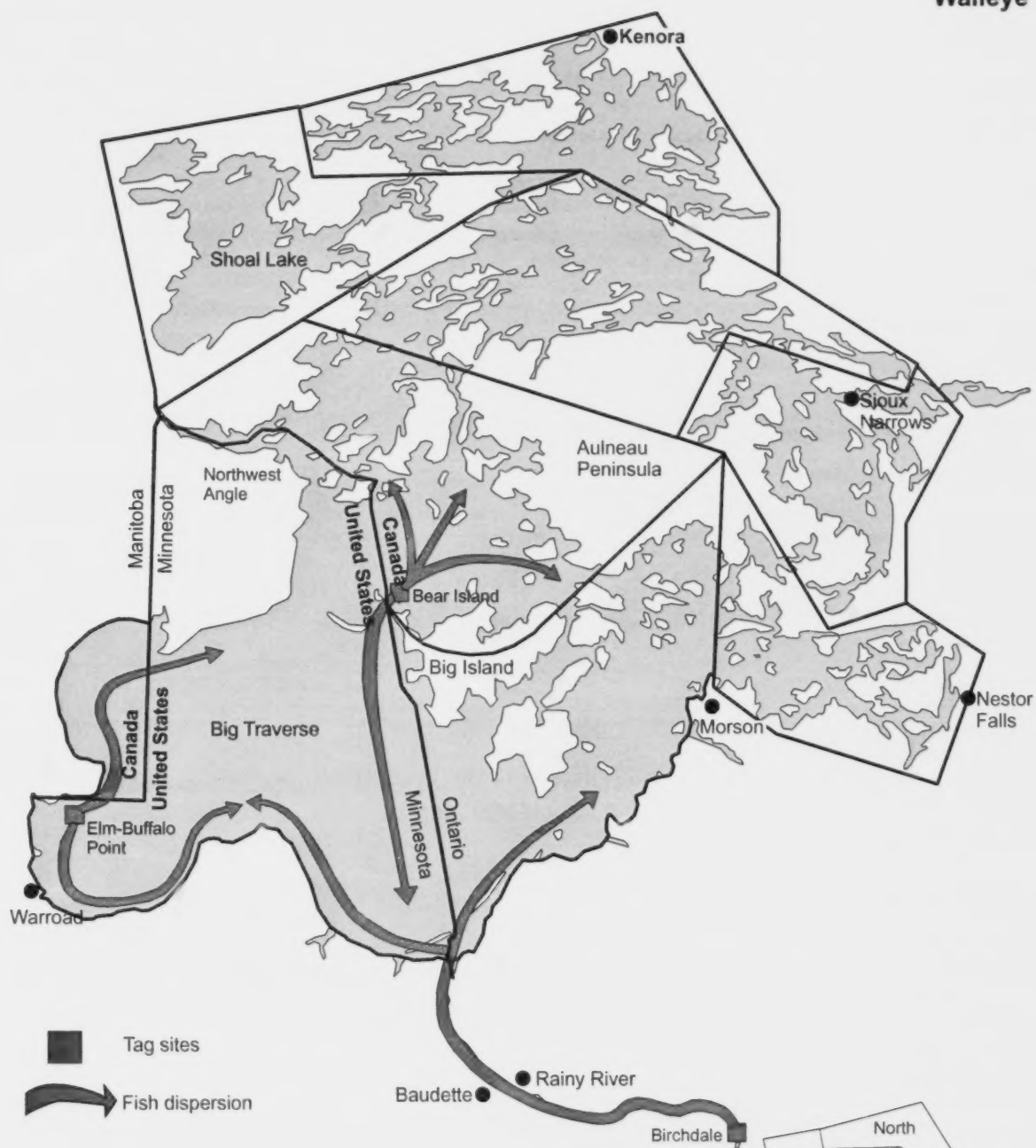
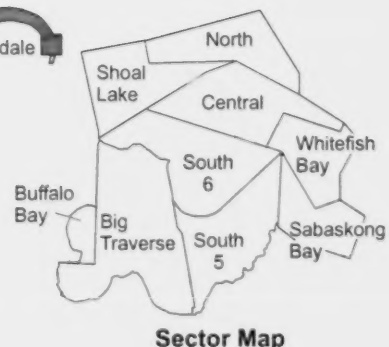
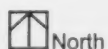
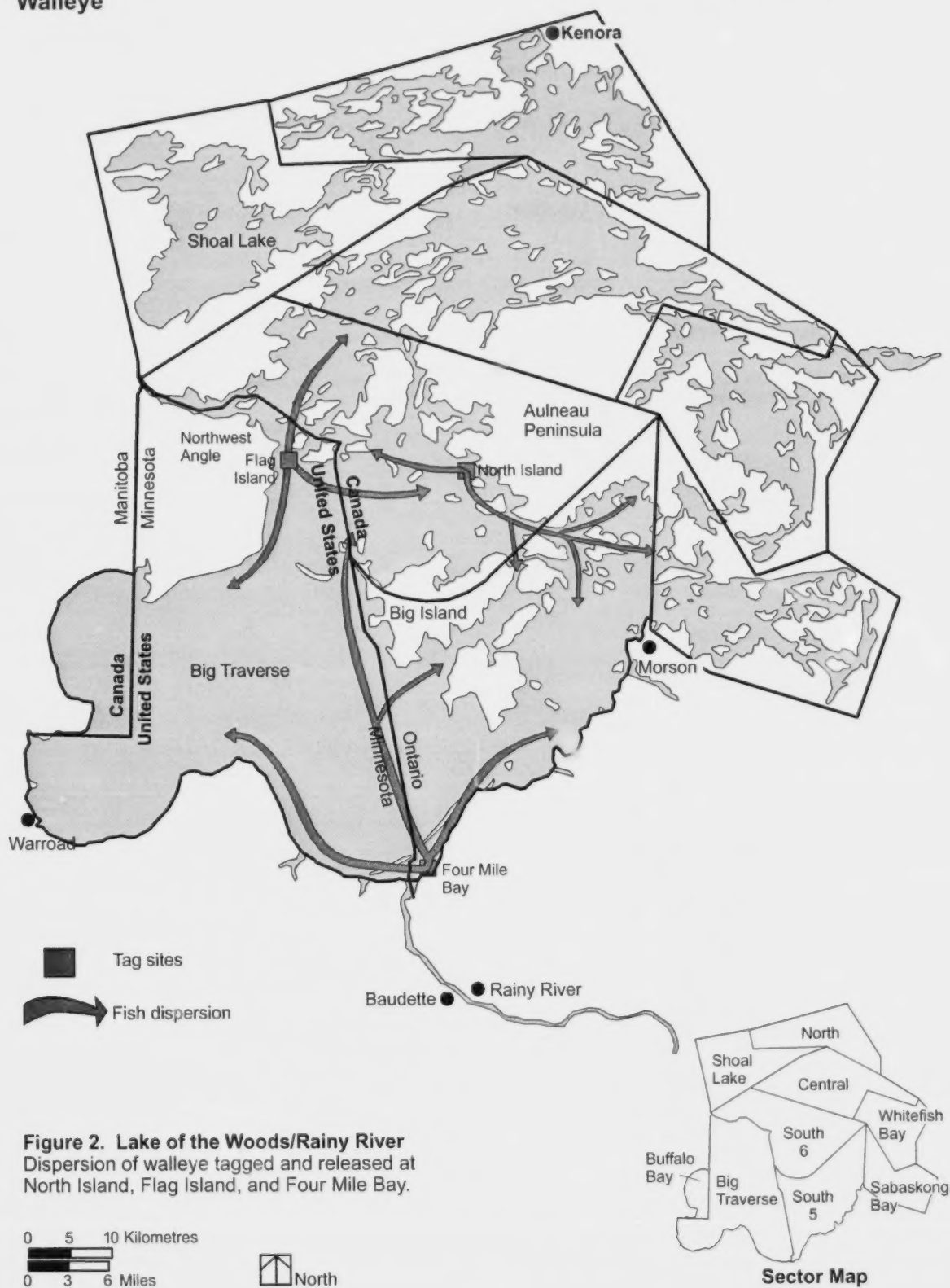


Figure 1. Lake of the Woods/Rainy River
Dispersion of walleye tagged and released at
Birchdale, Elm Point/Buffer Bay, and Bear Island.

0 5 10 Kilometres
0 3 6 Miles



Walleye



Lake Sturgeon

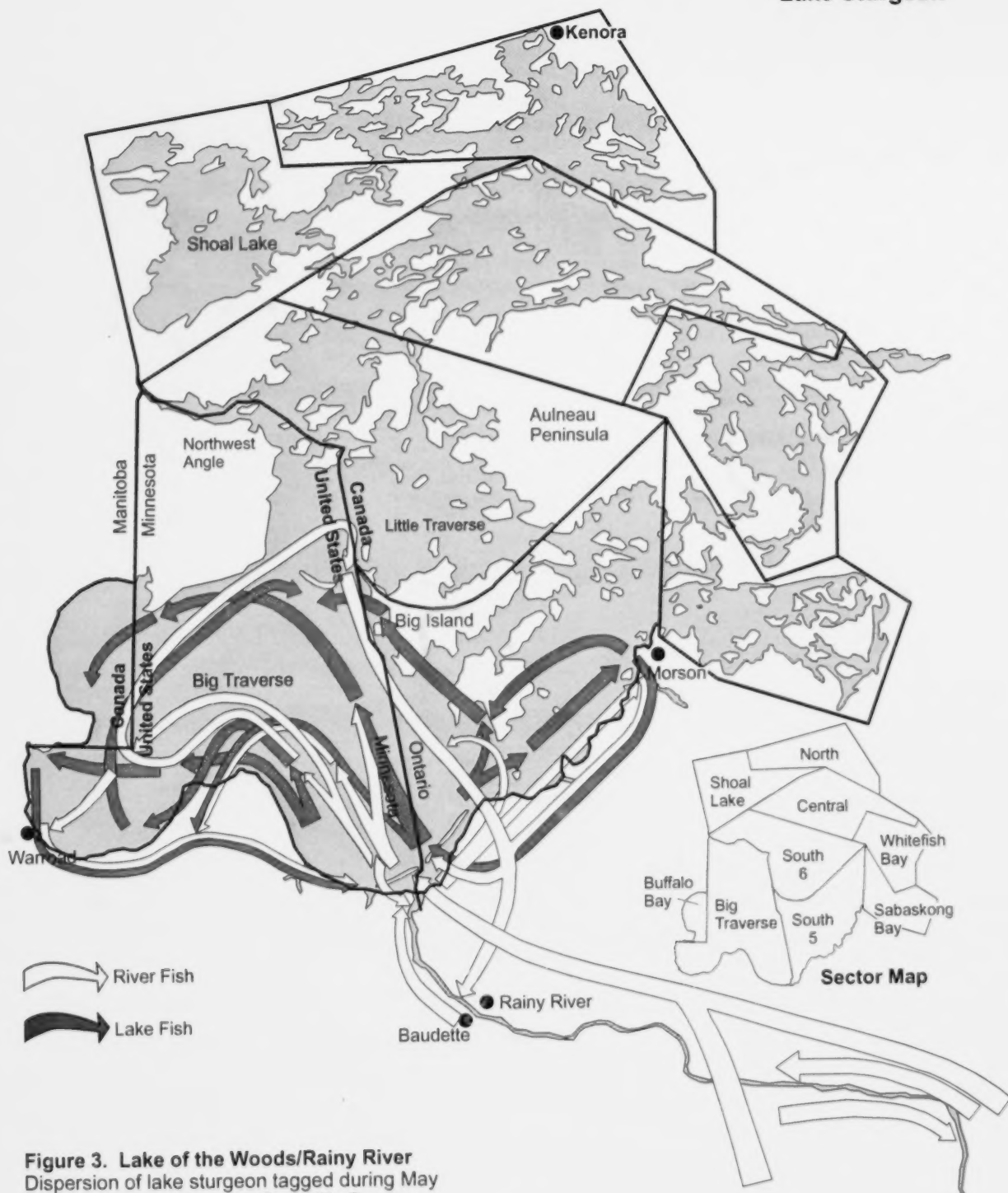
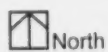


Figure 3. Lake of the Woods/Rainy River
Dispersion of lake sturgeon tagged during May to August; radio-tagged at Four Mile Bay.

0 5 10 Kilometres
0 3 6 Miles



Walleye



Figure 4. Rainy Lake
Dispersion of walleye tagged and released.

to address concerns that fish caught during catch and release tournaments in Ontario waters would remain at the release site and not return to their home range or sector where they were captured. A study, funded by the Community Fisheries and Wildlife Involvement Program (CFWIP), was initiated by OMNR and volunteers to determine the "normal" movements of smallmouth bass in Lake of the Woods, and whether displaced bass were capable of finding their way "home". The movements of 38 male smallmouth bass, equipped with internal radio tags, were tracked as part of either the control or displacement components of the experiment. The control component followed the normal movements of bass within three different "habitat" types, based on food abundance and water quality. In the displacement experiment, the movements of displaced bass were tracked over three different routes, involving increasing distance and complexity.

The results of the control component indicated that smallmouth bass in Lake of the Woods tend to be quite sedentary. Bass moved 2 to 4 km (1–2.5 miles) from their nest locations, and spent most of the summer months at one or two specific locations along a shoreline or reef. One individual spent the entire summer within 20 to 40 m (65–130 ft) of the nest location that had an extremely high crayfish density.

Results from the displacement component indicated that smallmouth bass have the ability to find their way home from great distances and through complex systems, but few appeared to exercise this ability. While three of the four individuals that were moved a short distance from their normal summer range returned within two to four weeks, less than one-half of the bass displaced over a longer distance returned to their summer range. Only two of 13 displaced bass were able to negotiate the longest distance and most complex route.

Based on results of this telemetry study, it seems highly unlikely that bass captured at greatest distance from tournament locations would return to their home range. However, the practice of transporting bass back to their home "sector" by truck or boat should alleviate concerns about loss of fishing opportunities in sectors away from tournament sites. Of the six displaced bass that did not return to their home range and were located in the spring, all had successfully established new nest sites. It would appear that displacement does not adversely affect a male's ability to establish a new nest site. However, there is evidence to suggest that displacement increases mortality. While only two of 14 control bass died, 12 of the 22 (55%) displaced bass died during this experiment. In contrast to control bass which remained relatively sedentary, displaced

bass spent much of the summer roaming shorelines, often travelling great distances in search of their way "home" or a new home range. This behaviour, resulting in greater stress and expenditure of energy, may have contributed to higher mortality rates.

A similar study has been initiated for large-mouth bass *Micropterus salmoides*.

Rainy Lake

Walleye spawning stocks have been tagged at seven sites in Rainy Lake:

- North Arm at Footprint River, Northwest Bay;
- North Arm at Wasaw Creek, Stanjikoming Bay;
- Redgut Bay at Sand Island Falls;
- South Arm at Rat River, Ontario;
- South Arm at Stokes Bay, Ontario;
- South Arm at Berry Island, Ontario; and
- South Arm at Black Bay, Minnesota (Figure 4).

Walleye tagged during the spawning period in the Ontario North Arm remained in that basin and generally dispersed east and north. Native walleye implanted with radio transmitters also remained in the North Arm with some late summer and fall foraging movements outside of Northwest Bay, east and north to the deeper waters of the basin. Spring spawning occurred at river and shoal spawning locations in the Northwest Bay area. Walleye tagged at Sand Island Falls on Redgut Bay remained within this bay, moving west and south. Fish tagged in the South Arm moved freely across the international border between Minnesota and Ontario. Movement was in all directions, but remained within the South Arm, suggesting that South Arm fish are a shared walleye stock.

Northern pike have also been tagged in the North Arm at Footprint River, Northwest Bay. Fish tagged during the spawning period remained in that basin with little or no dispersal from the Northwest Bay area.

Smallmouth bass movements have been studied in Ontario since 1995 through tagging in conjunction with the Fort Frances Canadian Bass Championship. As in Lake of the Woods, bass were tagged to evaluate the effects of displacement in a large lake and to assess tournament release procedures to minimize these effects. A total of 2,460 bass have been tagged, with 316 reported recaptures or a 12.8% recapture rate. Average movements of 8 km (5 miles) between basins have been reported, while maximum distances travelled at recapture have been estimated at 38 km (24 miles).

A study to investigate the distribution of **lake sturgeon** stocks in the South Arm of Rainy Lake and the Lower Seine River system was initiated in

2002. Fish tagging and radio-telemetry are being used to monitor fish movements and determine critical spawning habitats. Early observations suggest that extensive fish movements occur throughout the entire South Arm basin from known spawning and tagging sites. Both upstream and downstream movements (and intermixing) of fish between Rainy Lake and the Seine River have been observed.

Namakan Reservoir

Walleye and northern pike were tagged in Kabetogama Lake, the western most basin of Namakan Reservoir, in the 1980s. Tag returns indicated little movement of the fish into other basins. A recent genetics study of northern pike in Kabetogama (Miller *et al.* 2001) showed that pike exhibited spawning site and natal site fidelity. Differences in growth rates in the different basins of Namakan Reservoir also suggested that there is relatively little movement between basins. Further investigations of fish movement, distribution, and stock discreteness are required to support future management.

Studies involving genetic analysis of lake sturgeon and northern pike stocks across the boundary waters area were initiated in 2003 to further evaluate stock discreteness.

Lake Sturgeon Recovery

Lake sturgeon were an important component of the original fish community in the border waters area, including the south end of Lake of the Woods, Rainy River, and Rainy, Namakan, Lac la Croix and Sand Point lakes. Populations collapsed in the early 1900s, primarily due to commercial overfishing. Other factors such as the loss of spawning and nursery habitat in the Rainy River from paper mill pollution have been implicated. Populations in the Rainy River and Lake of the Woods now appear to be making a recovery in response to improved waste water treatment and subsequent water quality improvement since the 1970s. Various aspects of lake sturgeon biology in Lake of the Woods and the Rainy River were examined by a joint Ontario-Minnesota study from 1987 to 1991.

Working together, Ontario, Minnesota, and Rainy River First Nation biologists have recently written a management plan with the common objective of re-establishing and maintaining self-sustaining sturgeon stocks in all suitable habitats within the Ontario-Minnesota border waters. These stocks should provide subsistence and limited recreational and commercial fisheries, with

opportunities to encounter trophy sized fish greater than 183 cm (72 inches) in length. A population would be considered to be "recovered", if it possessed age, size, abundance, and brood stock characteristics, similar to unexploited or lightly exploited populations. The Border Waters Lake Sturgeon Committee has drafted short- and long-term goals for shared lake sturgeon stocks.

The **short-range goals** (next 5 to 10 years) are to rehabilitate self-sustaining stocks of lake sturgeon that will provide limited subsistence and recreational harvests. The lake sturgeon populations will have the following characteristics during rehabilitation:

- male fish up to age 30
- female fish up to age 50
- female fish exceeding 177 cm (70 inches) total length
- at least 30 year-classes
- support harvests at 0.04 kg per ha (0.04 pounds per acre) of available habitat

The **long-range goals** (next 20 to 30 years) are to maintain healthy, self-sustaining stocks of lake sturgeon that will provide subsistence, along with limited recreational and commercial harvests. Evaluation criteria would include the following:

- male fish up to age 40
- female fish up to age 70
- 10 to 15% of the population mature
- some female fish present larger than 200 cm (80 inches) in length
- at least 40 year-classes
- densities of age 2 and older fish at 160 fish/km (250 fish/mile) in rivers and 1.5 fish/hectare (1.5 fish/acre) in lakes
- annual fishing mortality of less than 5%
- support harvests at 0.1 kg per ha (0.1 pounds per acre) of available habitat

Rainy River stream flow management is a concern for lake sturgeon spawning and reproduction. Federal Energy Regulatory Commission (FERC) and International Joint Commission (IJC) licensing of the Boise Cascade and Abitibi Consolidated hydropower dam allows daily peaking of stream flows. Documented cases of de-watering lake sturgeon spawning sites have caused the loss of eggs, fry, and habitat.

Habitat and Other Management Activities

Agencies work together collectively and have a broad involvement in a variety of management activities such as water flow, water levels, watershed management, aquatic habitat protection, etc.

The Ontario-Minnesota Fisheries Committee has established a subcommittee to review the impacts of daily peaking on Rainy River. Their task is to make recommendations to the technical committee and the IJC to reduce or remove negative impacts of peaking operation.

An international work group, the Rule Curve Monitoring Committee, has been formed to evaluate the environmental impacts of the 2000 IJC supplementary order for regulating water levels on Rainy Lake and Namakan Reservoir. The committee is composed of members from OMNR, MDNR, VNP, and USGS.

Status of the Fishery Resource

Lake of the Woods/Rainy River Fishery Resource

Description of the Waters

Lake of the Woods is situated on the Canada-United States border between northwestern Ontario, southeastern Manitoba, and northwestern Minnesota. Its waters cover an area of 385,000 hectares (951,300 acres), two-thirds of which are in Canada. Although irregular in shape, the lake at its widest spans 105 km (65 miles) in a north-south direction and 90 km (56 miles) east-west. Lake of the Woods is comprised of a series of basins with unique limnological characteristics. On average, the lake is relatively shallow, with an average depth estimated at 7.9 m (26 feet). The maximum recorded depth is 65.8 m (216 ft) in Whitefish Bay. Lake waters flow north to Hudson Bay through three outlets into the Winnipeg River at Kenora. Dams on two of the principal outlets regulate water levels and allow for electricity generation. Under these controlled conditions, water levels fluctuate annually between 0.9 m (3 ft) and 1.2 m (4 ft). Water transparency is low in most areas. Mid-summer (August) secchi disc readings (a measure of water clarity) range from a visibility of less than 0.6 m (2.0 ft) in the southern portion to 5.5 m (18.0 ft) in Whitefish Bay. The low August water transparencies are caused by dense blooms of blue-green algae.

Rainy River is the primary tributary to Lake of the Woods, contributing over 70 percent of the inflow. The Rainy River flows approximately 128 km (80 miles) from the Rainy Lake outlet at Fort Frances-International Falls to its mouth at Four Mile Bay near the extreme south end of Lake of the Woods. It covers a total surface area of approximately 5,325 ha (13,160 acres), and its flows are controlled by a hydroelectric dam located at the Rainy Lake outlet. Major tributaries include the Big Fork, Little Fork, and Rapid rivers on the Minnesota side and the Pinewood, Sturgeon, and La Vallee rivers on the Ontario side.

Introduced fish species that were not part of the original fish community but have become established in Lake of the Woods/Rainy River include smallmouth and largemouth bass, black crappie, longear sunfish *Lepomis megalotis*, black bullhead *Ictalurus melas*, and rainbow smelt. Smelt were first observed near the mouth of the Rainy River in 1991, and have since become established in all parts of the lake including Whitefish Bay (1999) and Shoal Lake (1999). They

have become incorporated into the diets of most predator fish species. Impacts of smelt on the native lake trout, walleye, lake whitefish, and lake herring or cisco *Coregonus artedii* populations in these lakes are unknown at this time. Smelt in similar lakes have produced faster growth rates in adult walleye, but do not appear to have affected other walleye life stages. Lake whitefish and lake herring recruitment may be reduced by smelt. Rusty crayfish *Orconectes rusticus* were first found in Whitefish Bay in the late 1960s, and have since dispersed throughout Lake of the Woods.

Changes to Angling Regulations

Ontario

A number of changes to angling regulations in the Ontario portions of Lake of the Woods and the Rainy River have been made by the Ontario Ministry of Natural Resources since the publication of the last Atlas in 1998.

The Canadian resident daily catch/possession limit for walleye and sauger (or any combination thereof) was reduced from six (6) to four (4), two (2) with a Conservation Licence, with only one (1) greater than 46 cm (18 inches) in total length. Non-residents of Canada, fishing in the border waters area, are limited to two (2) walleye/sauger, with four (4) in possession, only one (1) greater than 46 cm. The daily catch/possession limit for the Rainy River was reduced to two (2) walleye/sauger from March 1 to April 14, none greater than 46 cm (18 inches).

The daily catch/possession limit for northern pike was reduced from six (6) to four (4), two (2) with a Conservation Licence, none between 70 and 90 cm (27.5–35.4 inches) in length, and only one greater than 90 cm.

The daily catch/possession limit for largemouth and smallmouth bass (or any combination thereof) during July 1 to November 30 was reduced from six (6) to four (4), two (2) with a Conservation Licence. During December 1 to June 30, two (2) bass may be taken daily, one (1) with a Conservation Licence, none greater than 35 cm (13.8 inches). Large and smallmouth bass catch and release only is permitted on Lake of the Woods and Shoal Lake from June 1 to June 30.

Daily catch/possession limits were also reduced for the following species: yellow perch fifty (50); black crappie fifteen (15), ten (10) with a Conservation Licence; lake whitefish, twenty-five (25).

The minimum length regulation for muskellunge *Esox masquinongy* was increased from 122 cm (48 inches) to 137 cm (54 inches) for Lake of the Woods and Shoal Lake, and from 102

cm (40 inches) to 122 cm (48 inches) for the Rainy River from the dam at Fort Frances downstream to Wheeler's Point on Lake of the Woods.

Minnesota

Minnesota introduced an experimental regulation for northern pike consisting of a 76–102 cm (30–40 inches) protected slot; with a possession limit of three (3), of which only one (1) may be longer than 102 cm (40 inches).

The daily catch and possession limit for walleye/sauger on Lake of the Woods during the period from the May "opener" to November 30 was reduced to eight (8) fish, not more than six (6) can be walleye. During December 1 to April 14, 14 walleye/sauger may be taken daily, not more than six (6) can be walleye. Only one (1) walleye over 50 cm (19.5 inches) can be taken during the open season.

Special regulations were established on the Rainy River during March 1 through April 14, whereby anglers can harvest only two (2) walleye per day, none of which can exceed 50 cm (19.5 inches) total length.

Minnesota implemented new regulations for lake sturgeon in Lake of the Woods and the Rainy River in 2004. These included a harvest slot (114–127 cm or 45–50 inches total length), one (1) lake sturgeon per licence year and an open angling season from July 1 through May 16. Sturgeon harvest will be allowed from April 24 through May 7 and from July 1 through September 30, with catch and release fishing only during the remainder of the open season.

Current Fish Stock Status

Potential yields, annual harvests, and past management objectives were compared to assess the status of walleye, northern pike, smallmouth/largemouth bass, sauger, yellow perch, black crappie, and lake sturgeon in Lake of the Woods/Rainy River (Figures 5, 7, 9, 11, 13, 15, 17). Estimates for the Rainy River have been combined with those from Lake of the Woods.

The primary management goal is to maintain harvest levels at or below potential yield. This is especially important for species where recent annual harvests have exceeded potential yields, and where evidence indicates that stocks are stressed from overfishing.

Ontario

OMNR considers both allocation and management objectives when determining the management strategy for the Lake of the Woods fishery.

Walleye

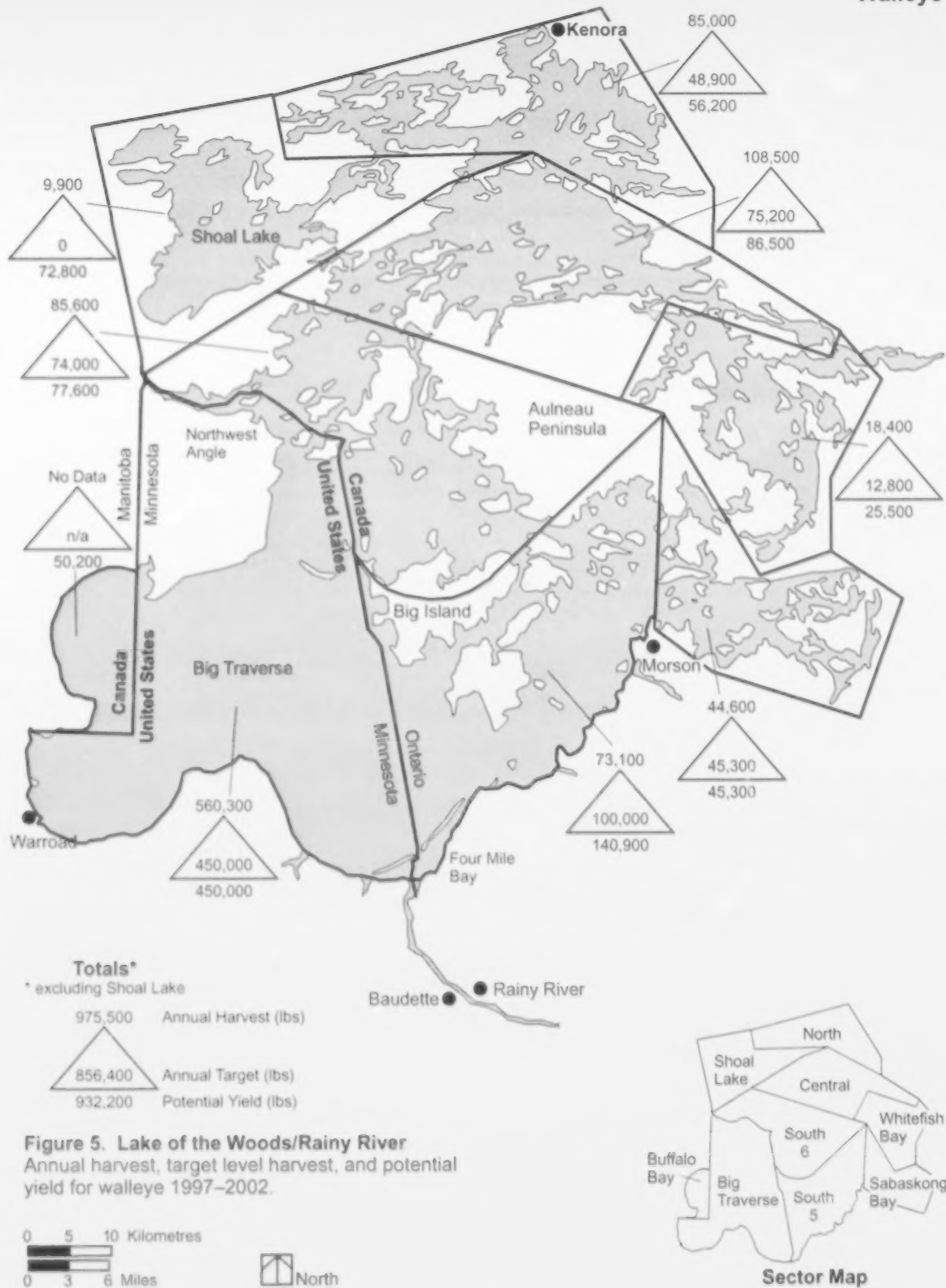


Figure 5. Lake of the Woods/Rainy River
 Annual harvest, target level harvest, and potential yield for walleye 1997-2002.

Walleye

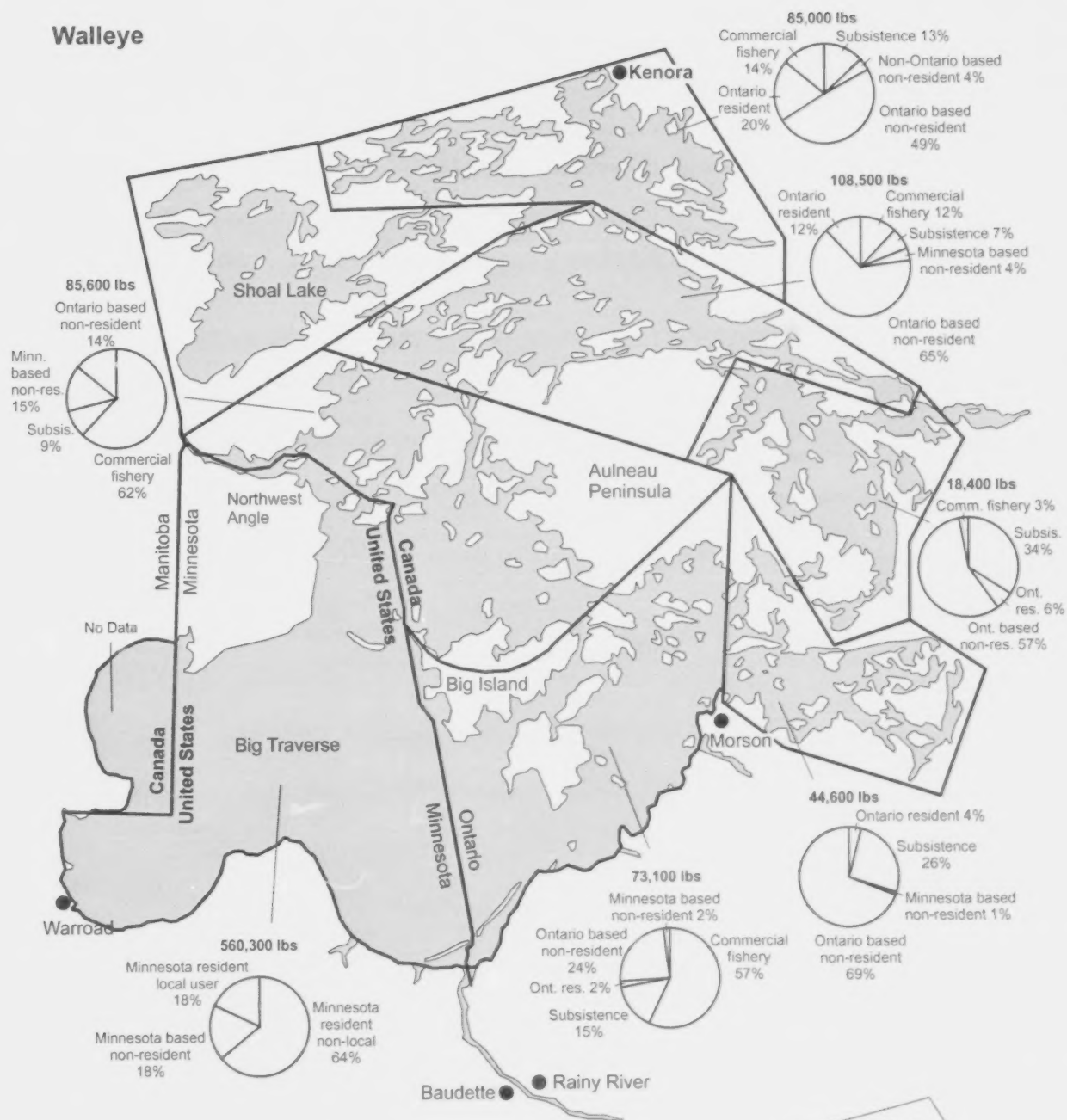


Figure 6. Lake of the Woods/Rainy River
 Walleye harvest by user group 1997-2002.

0 5 10 Kilometres
 0 3 6 Miles



Northern Pike

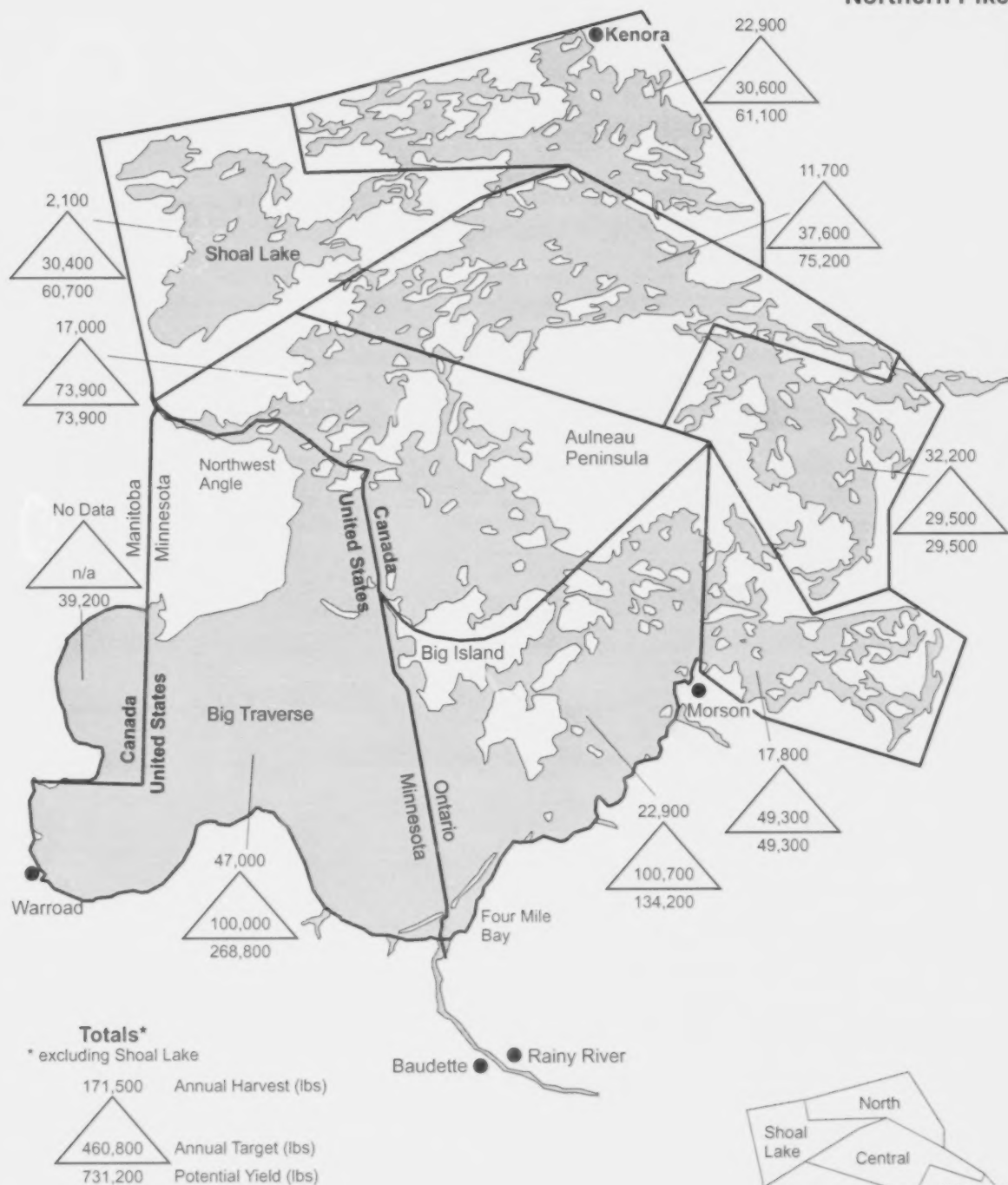
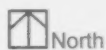


Figure 7. Lake of the Woods/Rainy River
 Annual harvest, target level harvest, and potential yield for northern pike 1997-2002.

0 5 10 Kilometres
 0 3 6 Miles



Northern Pike

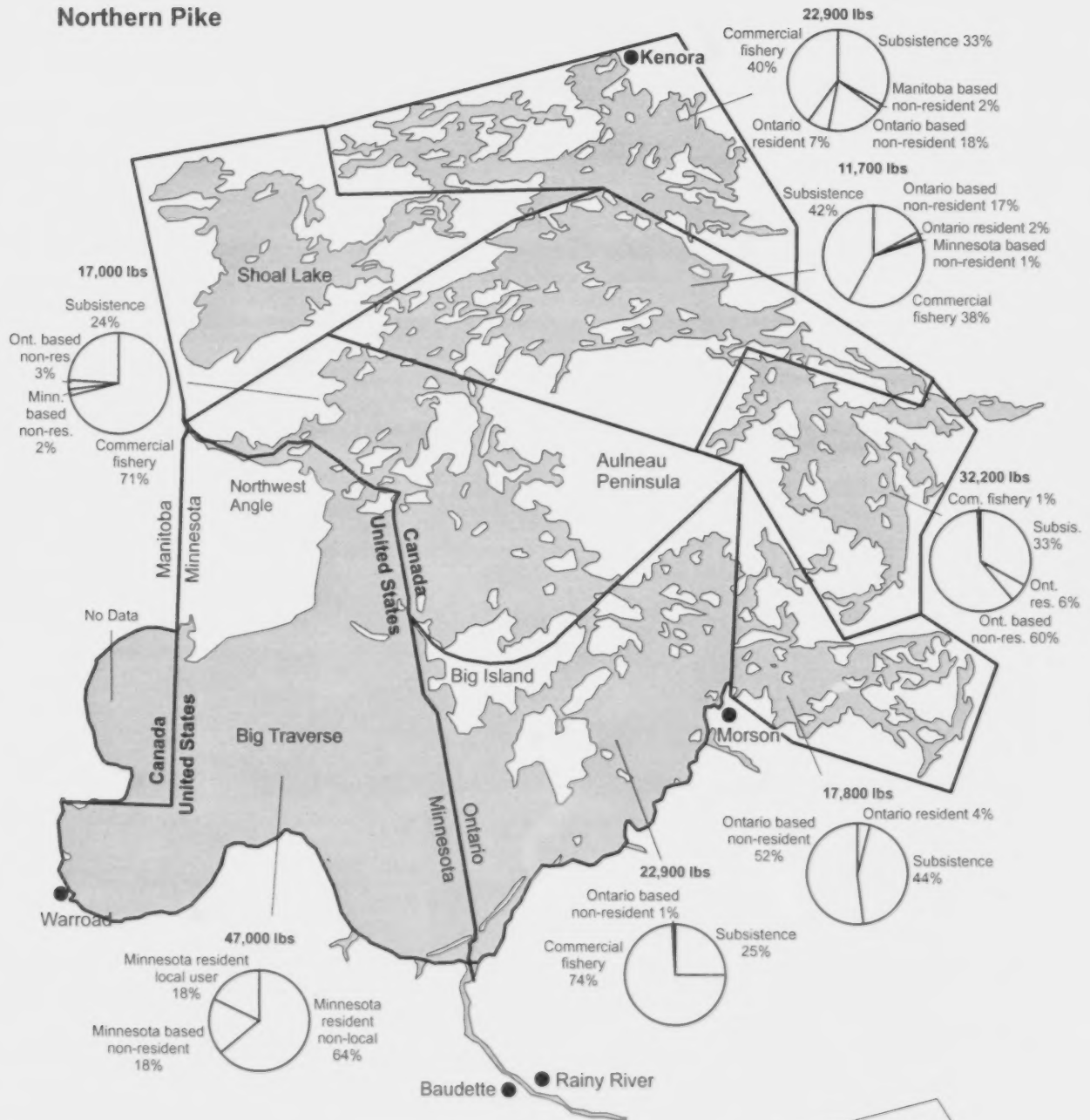
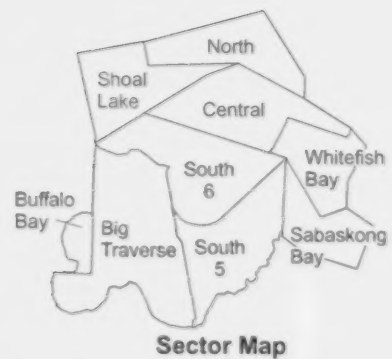
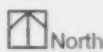


Figure 8. Lake of the Woods/Rainy River
Northern pike harvest by user group 1997-2002.

0 5 10 Kilometres
0 3 6 Miles



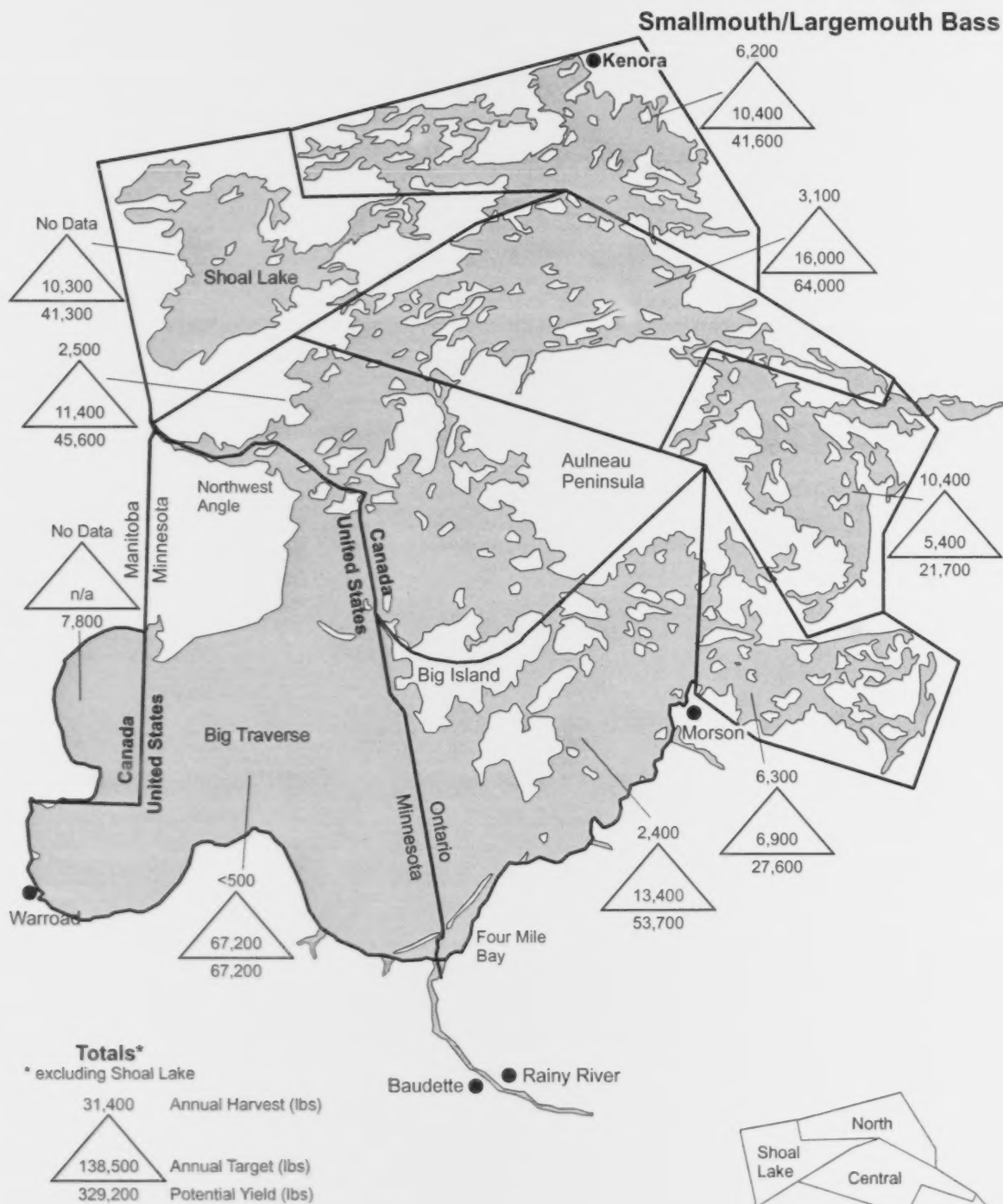
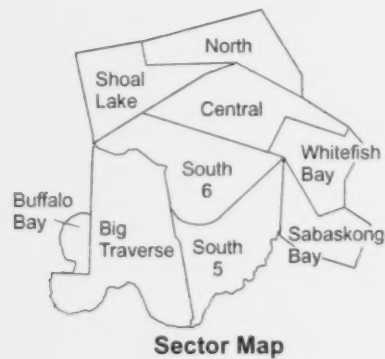
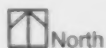


Figure 9. Lake of the Woods/Rainy River
 Annual harvest, target level harvest, and potential yield for smallmouth/largemouth bass 1997-2002.

0 5 10 Kilometres
 0 3 6 Miles



Smallmouth/Largemouth Bass

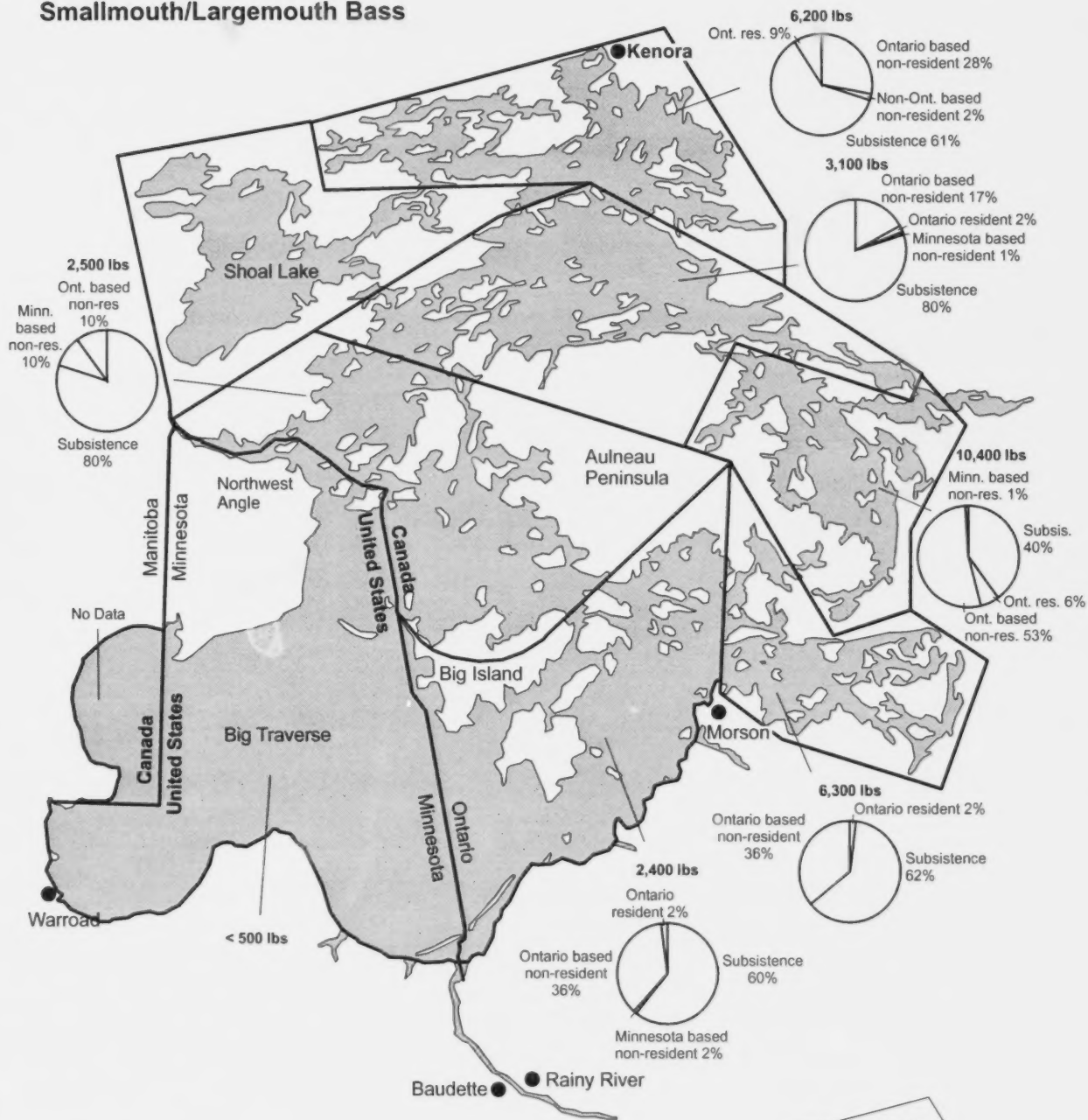
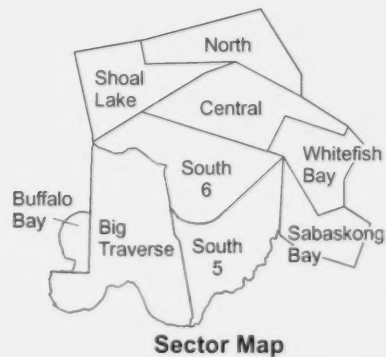
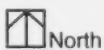


Figure 10. Lake of the Woods/Rainy River
Smallmouth/largemouth bass harvest by user group
1997-2002.

0 5 10 Kilometres
0 3 6 Miles



Sauger

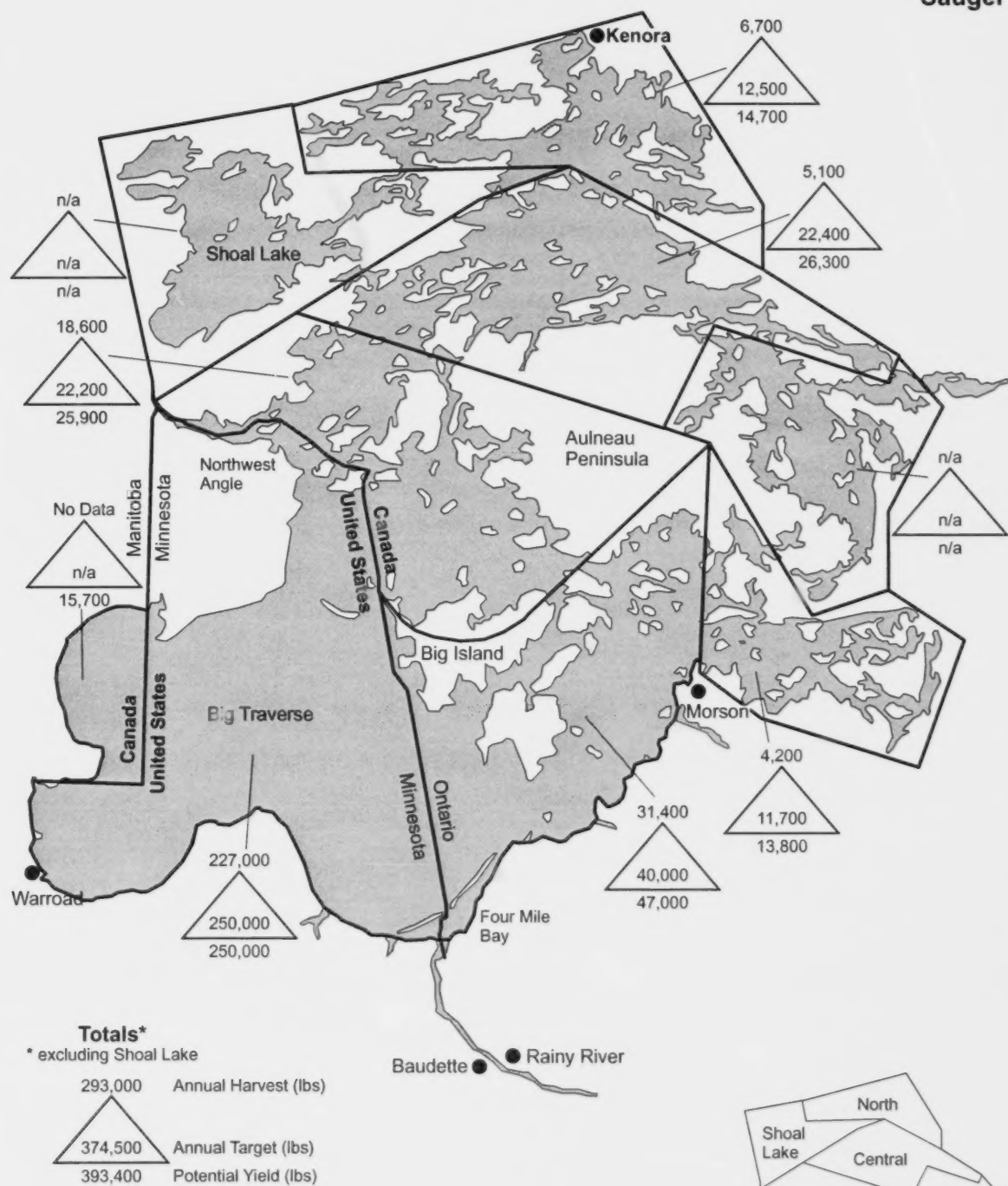
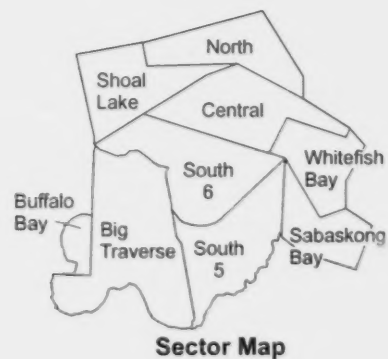
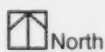


Figure 11. Lake of the Woods/Rainy River
 Annual harvest, target level harvest, and potential yield for sauger 1997-2002.

0 5 10 Kilometres
 0 3 6 Miles



Sauger

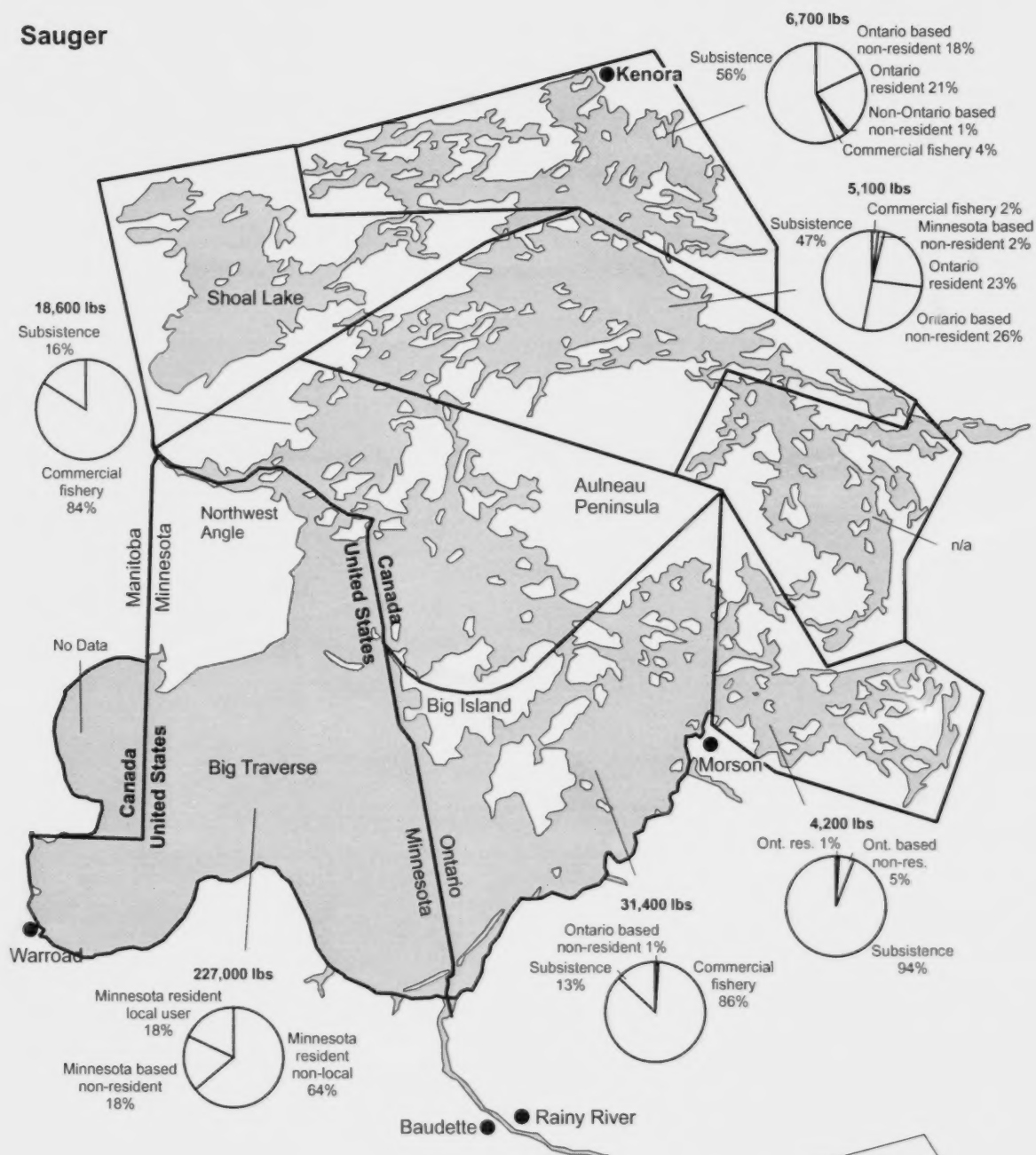
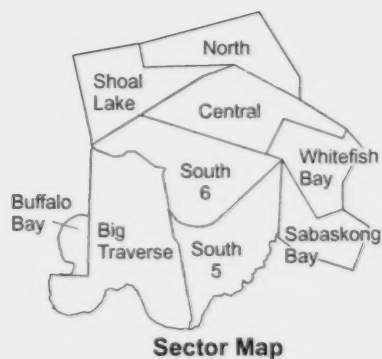
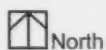


Figure 12. Lake of the Woods/Rainy River
Sauger harvest by user group 1997-2002.

0 5 10 Kilometres
0 3 6 Miles



Yellow Perch

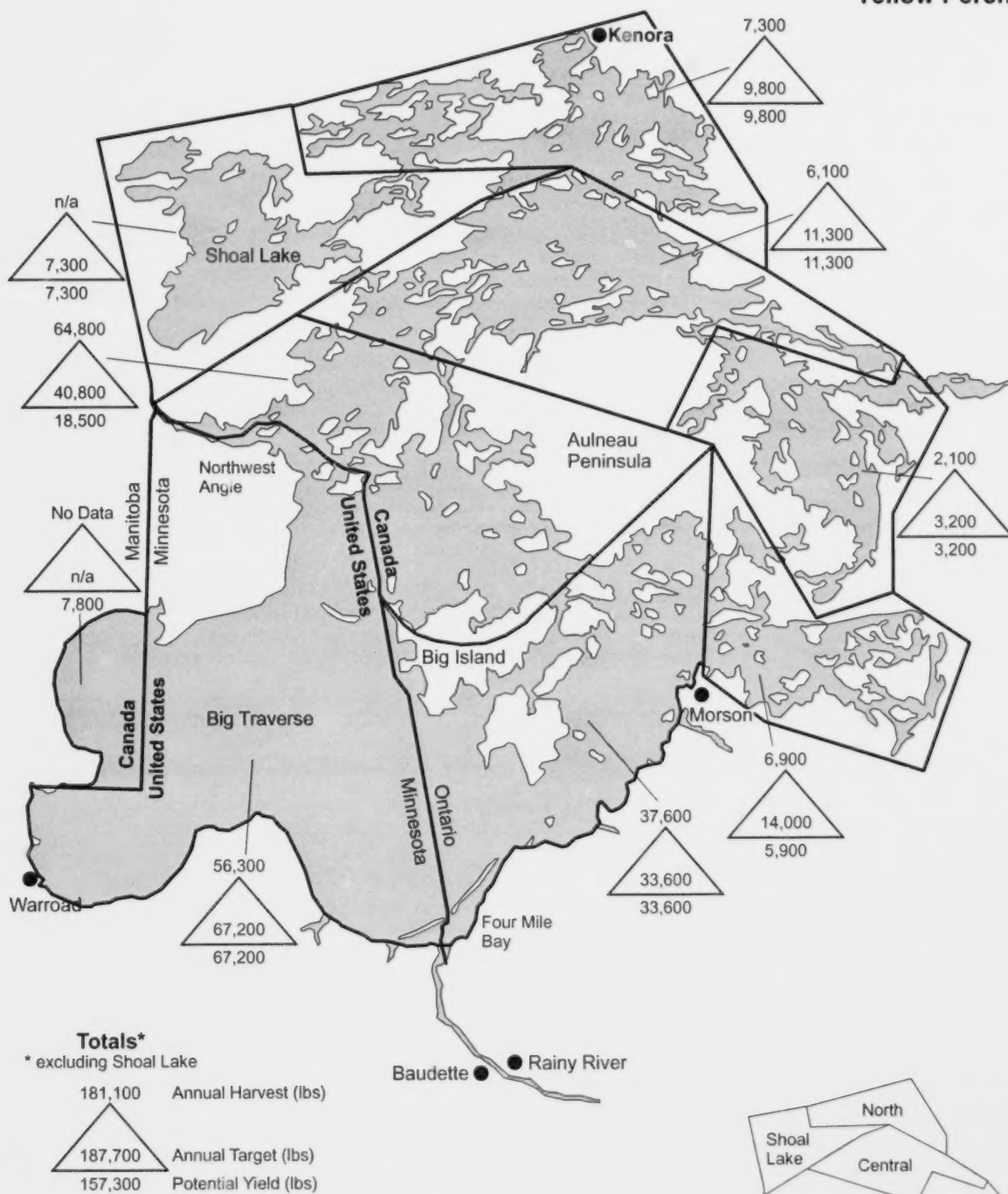
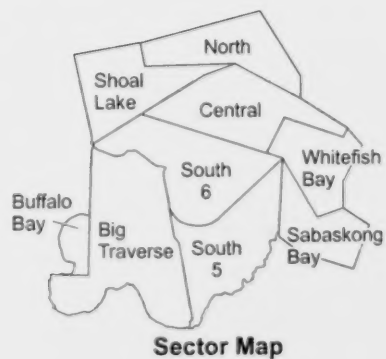
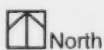


Figure 13. Lake of the Woods/Rainy River
 Annual harvest, target level harvest, and potential yield for yellow perch 1997–2002.

0 5 10 Kilometres
 0 3 6 Miles



Yellow Perch

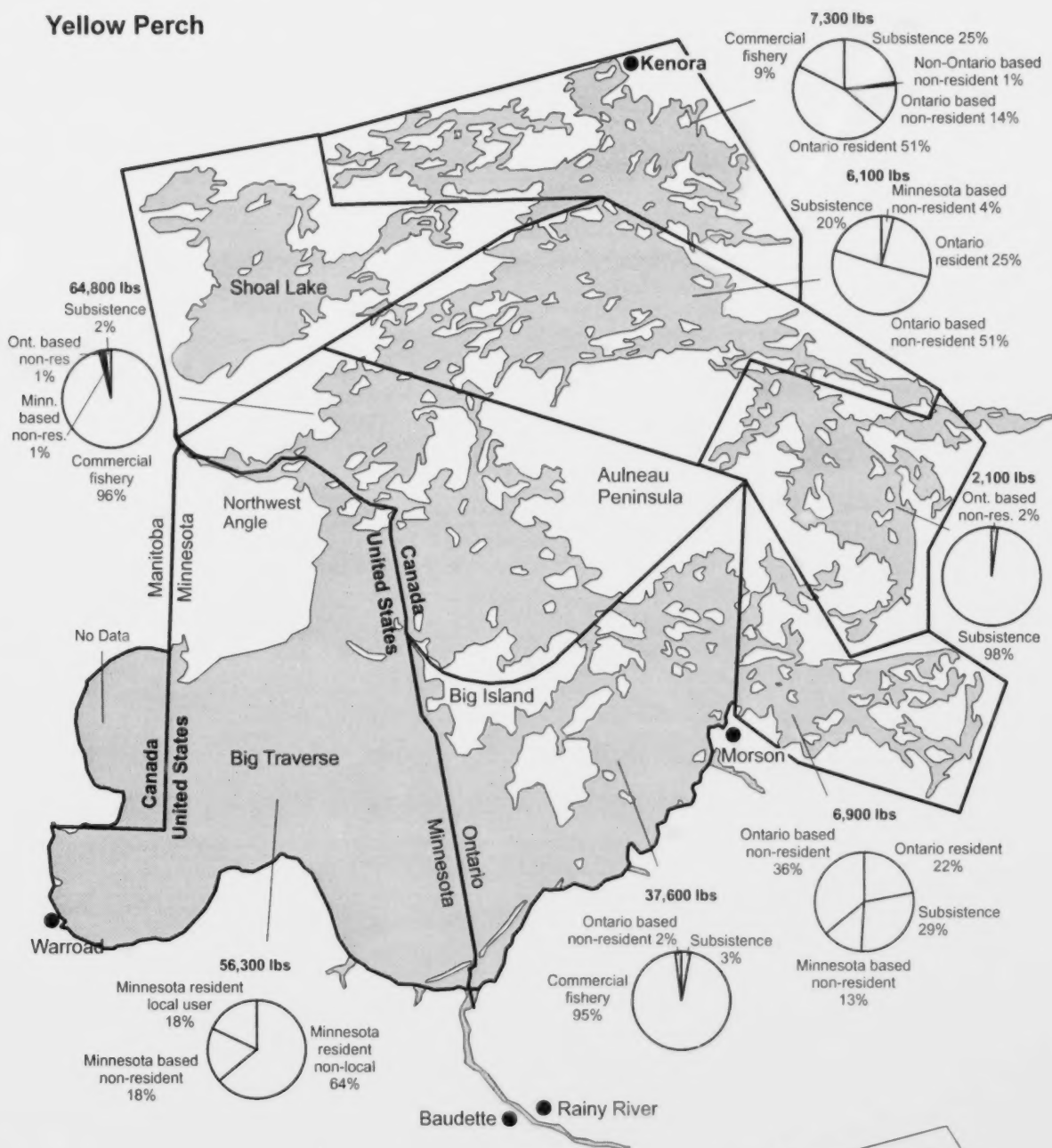
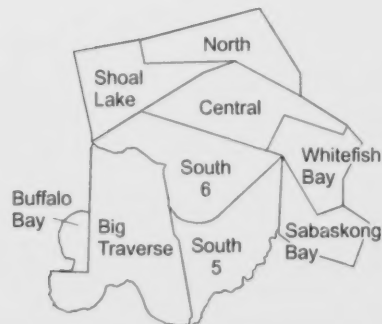
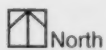


Figure 14. Lake of the Woods/Rainy River
Yellow perch harvest by user group 1997-2002.

0 5 10 Kilometres
0 3 6 Miles



Sector Map

Black Crappie

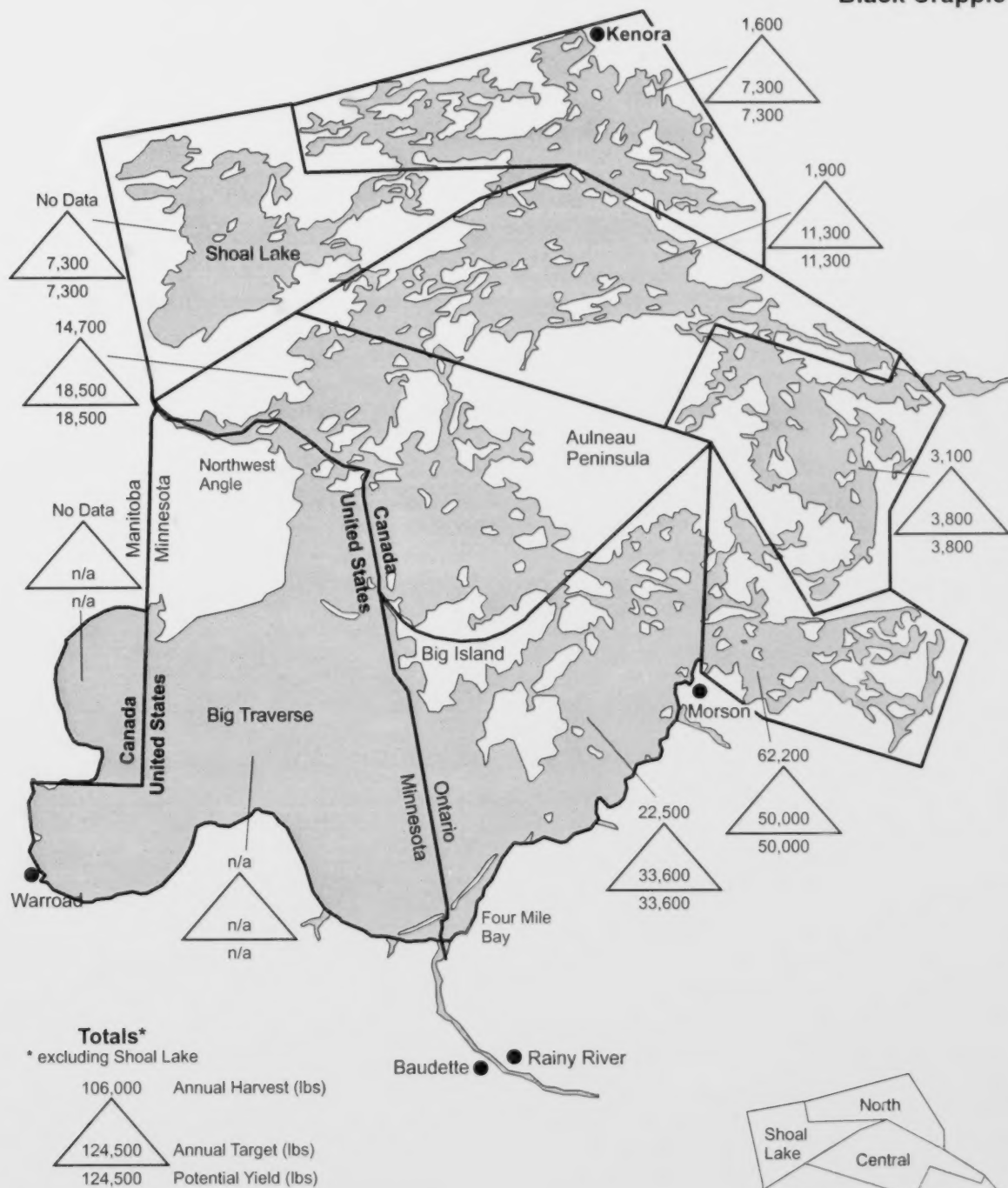
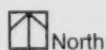
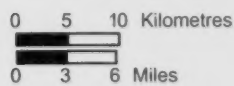


Figure 15. Lake of the Woods/Rainy River
 Annual harvest, target level harvest, and potential yield for black crappie 1997-2002.



Black Crappie

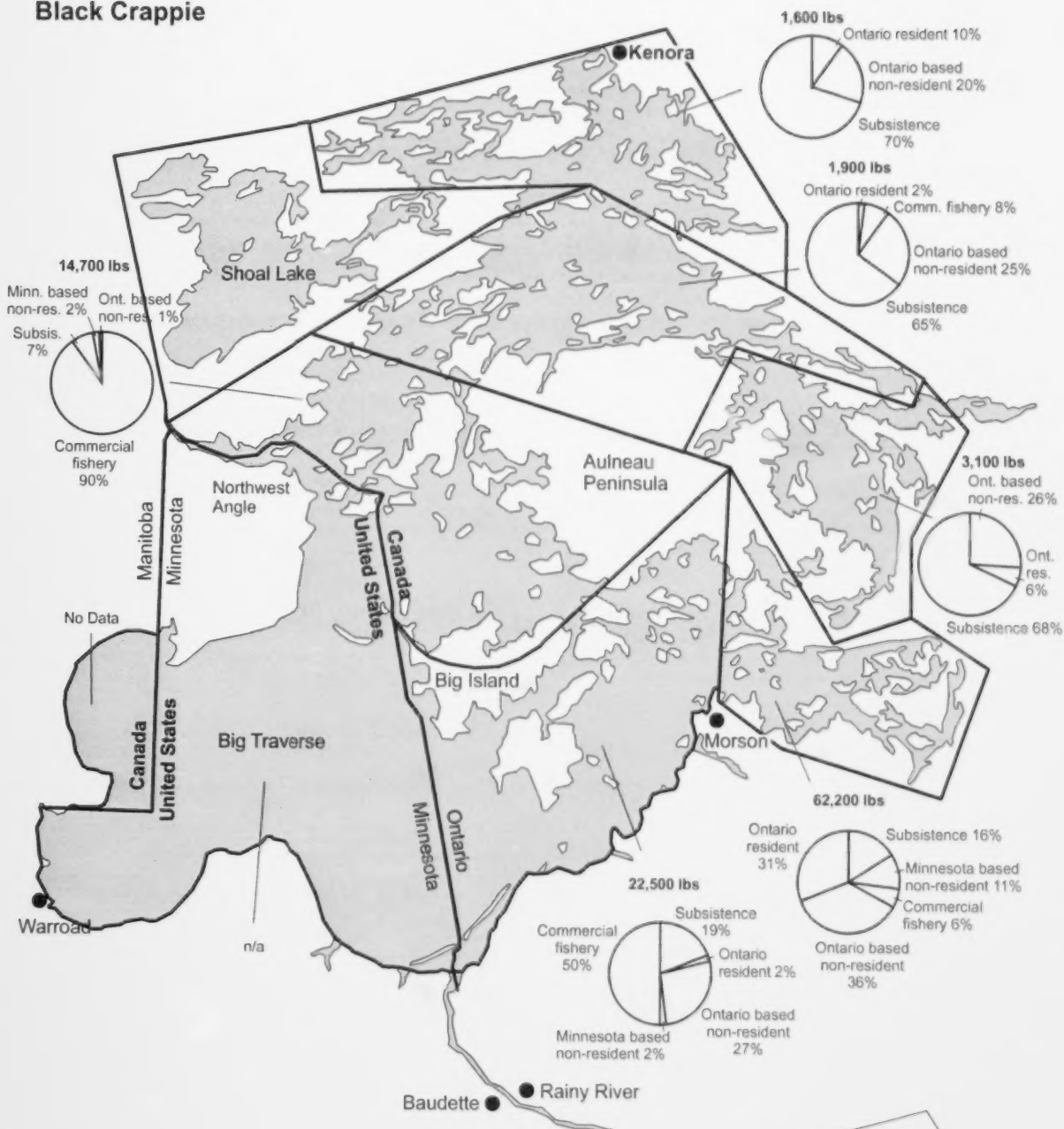
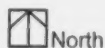
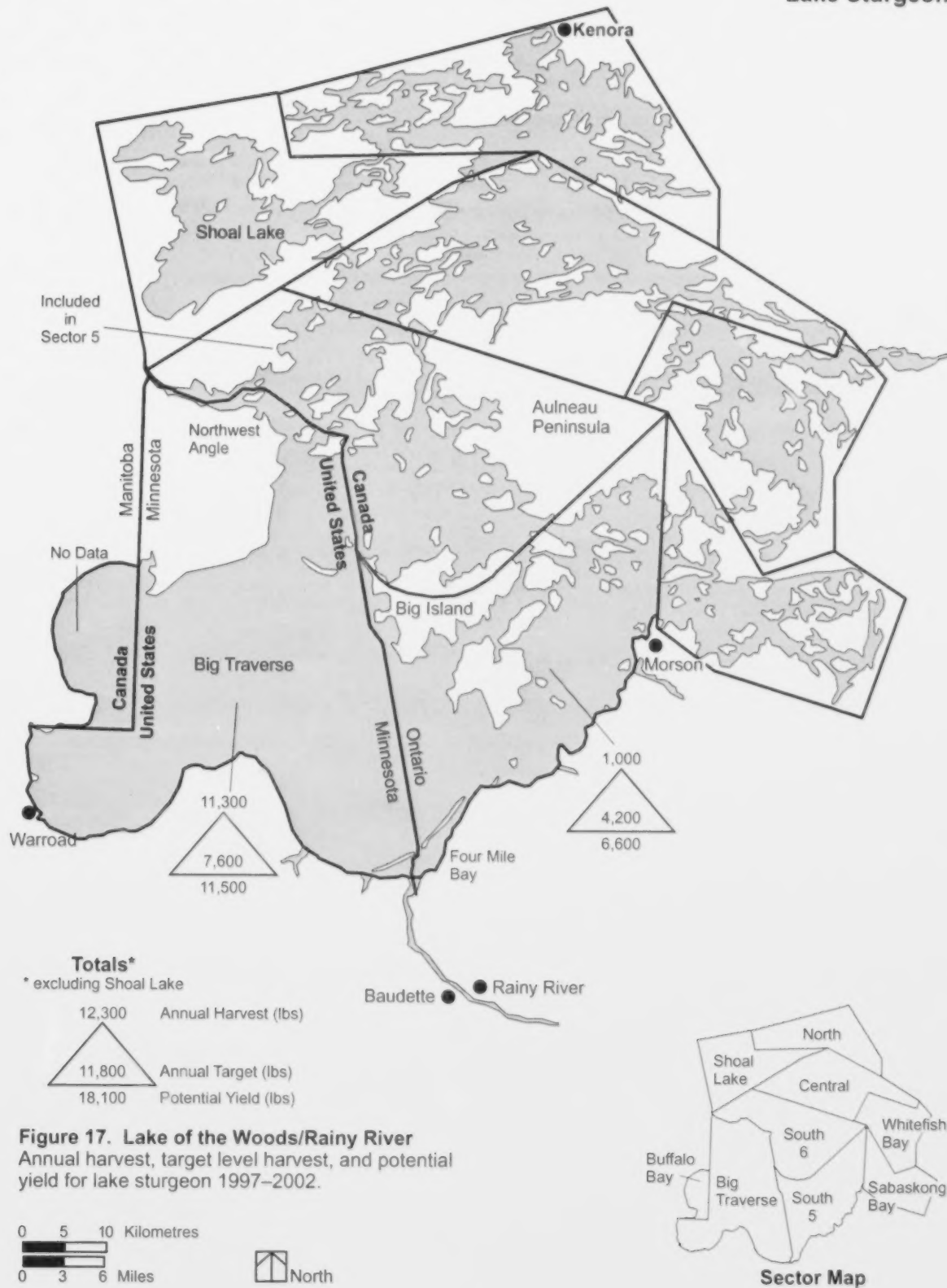


Figure 16. Lake of the Woods/Rainy River
Black crappie harvest by user group 1997–2002.

0 5 10 Kilometres
0 3 6 Miles



Lake Sturgeon



Allocation refers to how and who uses the fishery (e.g. subsistence, recreational, commercial). The allocation strategy is partially based upon the draft Allocation Policy Developed for Ontario Fisheries (OMNR 1978) and reflects both historical and present users of the fishery. The first allocation priority is for resource maintenance, the protection of the self-renewing production of the fisheries resource. The next priority is for First Nations subsistence and traditional needs. Remaining available surpluses are managed for the benefit of the resident recreational angler (which includes all residents of Canada) and the commercial fisheries. Commercial fisheries include both the commercial net fishery and the commercial angling fishery (e.g. tourism-based angling and competitive tournaments).

Management objectives reflect the type of fishery that is being managed for (e.g. quantity, quality, or rehabilitation), and most importantly, its current status. Where past overharvesting and/or habitat loss have resulted in the decline or collapse of a fishery, the management objective would be for rehabilitation (e.g. lake sturgeon in the Rainy River-Lake of the Woods and Shoal Lake walleye). During the recovery phase, allocation is limited to subsistence harvesting. Whitefish and yellow perch on Lake of the Woods are allocated primarily to the commercial net fishery. The management objective for these species is to provide the greatest economic benefits to commercial fishers without jeopardizing sustainability. Harvest is managed at the full potential yield for a quantity fishery. Conversely, lake trout, muskellunge, smallmouth and largemouth bass are targeted by anglers. These species are managed for a high catch rate with the emphasis on catch and release rather than consumption. The opportunity to catch a large or memorable (trophy) sized fish may also exist. In this case, the management objective is for a quality or trophy fishery with no allocation to the commercial net fishery. The management objective(s) for species sought after by both anglers and netters depends on the species' productive capacity, along with past and present use within a sector. For example, the majority of walleye and northern pike harvesting in Sectors 5 and 6 is by commercial netting and the management objective is for a quantity fishery. Although angling also occurs here, there is no expectation to manage walleye and northern pike as quality or trophy fisheries. In Sectors 1 and 2, where there is a high incidence of resident anglers and tourism, the management objective is to provide for quality fishing opportunities.

Ontario-North Sector

This sector, which covers the northern end of Lake of the Woods, has a surface area of 29,500 ha (72,800 acres), an estimated potential fish yield (Ryder 1965) of 3.77 kg/ha/yr (3.36 lbs/acre/yr) or 111,000 kg (244,300 lbs)/yr. It supports subsistence and commercial fishing, and both winter and openwater angling fisheries. This area, which experiences a high degree of use, owing to its close proximity to the Kenora-Keewatin population centre and to extensive cottage development on islands and surrounding shorelines, is often referred to as the Lake of the Woods "urban fishery". Two First Nations communities are also located directly on the shores of this sector. Anglers include local residents, non-resident property owners, non-resident guests at Ontario tourist facilities, non-resident campers, and non-residents based out of Manitoba and Minnesota (day trippers; see Users of the Fishery). The North Sector is subject to intense angling pressure during the openwater season from a number of Kenora-based angling tournaments, most notably the Kenora Bass International (KBI).

Walleye

The average annual walleye harvest from this sector (1997-2002) is estimated at 38,600 kg (85,000 lbs)/yr, which is above the potential yield estimate of 25,600 kg (56,200 lbs)/yr for this species (Figures 5 and 6). The current average annual harvest reflects an unusually high angling yield in 2002, likely in response to the recruitment of several strong walleye year-classes into the fishery. The 1999 reduction in daily catch limits would appear to have had limited effect on reducing harvests in this sector since the majority of anglers were Canadian residents or non-resident property owners who could still keep four (4) walleye/sauger per day, only one of which can exceed 46 cm (18 inches) in length. The daily catch and possession limit was also reduced for non-residents of Canada who are only allowed two (2) walleye/sauger per day with a maximum of four (4) in possession. Continuing expansion of the local resident winter fishery also contributed to increased walleye harvests in this sector.

Past assessments, following commercial fishery buy-outs in the mid-1980s, indicated an increase in the number of larger fish and older age groups present along with a decline in total mortality. However, a decline in overall abundance, an increase in growth, and faster maturity rates were observed during the most recent assessment period (1997-98). Although walleye populations in this sector remain healthy, the effects of increased

angling exploitation are beginning to erode past gains.

A management objective of 22,200 kg (48,900 lbs)/yr reflects the intent to maintain annual harvest at/or below the potential yield level, in order to manage for long-term stability and a quality walleye fishery in this sector.

Northern Pike

Annual harvest of northern pike from the North Sector averaged 10,400 kg (22,900 lbs)/yr, which was well within the estimated potential yield of 27,800 kg (61,100 lbs)/yr for this species (Figures 7 and 8). Past overharvests have been reduced by commercial fishery buy-outs, and increased catch and release by anglers. It would appear that the 1999 reduction in the daily catch and possession limit along with a protected slot size have proven effective in reducing angling harvests of pike in this sector. Recent assessments have indicated that pike populations in this area are stable with increased numbers of older age and larger size classes present. Although growth rates have increased, total mortality rates have declined and pike are maturing later in recent years than during initial assessments in the mid-1980s. It is the management objective to maintain annual harvests at 13,900 kg (30,600 lbs)/yr, which is 50% of the potential yield, in order to manage for a quality pike fishery in this area.

Smallmouth/Largemouth Bass

Smallmouth bass were introduced into the north end of the lake at the turn of the last century, and are now present throughout the North Sector. Largemouth bass, a more recent arrival, also occur throughout this sector. Bass have become a major component in the fish community and the target of an increasing number of anglers and angling tournaments. The current estimated harvest of 2,800 kg (6,200 lbs)/yr is well within the potential yield estimate of 18,900 kg (41,600 lbs)/yr for these two species (Figures 9 and 10). Concern over the selective harvest of large, trophy sized fish by anglers during the nesting period and the subsequent loss of each nest's reproductive potential, led to the implementation of a catch and release only season for bass on Lake of the Woods during the month of June, commencing in 1996. This regulation, along with the 1999 reduction in the daily catch and possession limit, has been largely responsible for a 50% decrease in bass harvests when compared to the previous 1990 to 1996 period. Recent assessments indicated that mean age and size of fish in index net catches have increased, maturity rates have increased, and mortality rates have declined over

the long term. Populations appear to be healthy. A management objective of 4,700 kg (10,400 lbs)/yr reflects the intent to manage for a quality bass fishery on Lake of the Woods by maintaining annual harvests at 25% of the potential yield level.

Sauger

Sauger annual harvests which averaged 3,100 kg (6,700 lbs)/yr remained unchanged from previous Atlas estimates, and were well within the potential yield estimate of 6,700 kg (14,700 lbs)/yr for this species (Figures 11 and 12). A major decline in sauger abundance and a shift in age/size class distributions to one dominated by younger fish occurred throughout the lake during the early 1990s. In the case of the North Sector, a 60% decline in abundance could not be related to harvest pressures. Several strong year-classes in recent years are helping populations recover to former levels. A management objective of 5,700 kg (12,500 lbs)/yr has been set, in order to manage for sustained recovery. Natural fluctuations in population abundance appear to be characteristic of this species on Lake of the Woods.

Yellow Perch

Average annual harvests of yellow perch have doubled from about 1,500 kg/yr (3,300 lbs) during 1990–96 to over 3,300 kg (7,300 lbs)/yr for the recent 1997–2002 period. Increased harvest by the angling fishery, especially during winter, was responsible for this change. Average annual harvests remained within the potential yield estimate and management objective of 4,500 kg (9,800 lbs)/yr (Figures 13 and 14). A broad range of age/size classes were present while growth and maturity rates were comparable to those of lightly fished populations in nearby sectors. The management objective of 4,500 kg (9,800 lbs)/yr reflects the intent to manage yellow perch at 100% of potential yield for a quantity fishery.

Lake Trout

Lake trout are resident only in the area west and northwest of the Northern Peninsula, primarily Clearwater, Cul de Sac, and Echo bays. The potential yield for this species has been estimated at 1,200 kg (2,500 lbs)/yr, based on a potential yield of 0.5 kg/ha/yr over a total surface area of 2,300 ha (5,700 acres). A loss of spawning grounds and deepwater summer habitat for lake trout has occurred, due to intensive shoreline development and increased nutrient input from surrounding areas. Winter angling for lake trout in this area was closed in 1988 to control overharvest. The Clearwater Bay Fisheries Advisory Committee recommended that

this fishery be managed under special trophy regulations, and that steps be taken to control loss of lake trout habitat in these waters. A lottery tag system was introduced in 1991, whereby only anglers in possession of a special non-reusable tag (seal) could harvest one (1) lake trout/angler/year. Tag numbers have been restricted to 110 per year. It was estimated that the combined angling and subsistence harvest of lake trout averaged about 250 kg (550 lbs)/yr since 1991.

Recent assessment netting confirmed that lake trout in Clearwater Bay and Cul de Sac continue to benefit from the harvest reduction, and that habitat conditions were still adequate for healthy lake trout populations. Both Cul de Sac and Clearwater Bay populations exhibited good abundance indices, a large number of year-classes (16 and 18, respectively), and good representation of both younger and older fish. Total mortality rates were low (20%), and maturity rates were typical for this species. Similarly, the Echo Bay lake trout population exhibited low mortality (< 20%), although abundance was low. Sixteen year-classes from age 7 to 23 years were present in spawning population samples, but year-class strengths were highly variable. Since harvest has been restricted through the tag system, assessment results indicated that recruitment may be limited in Echo Bay. Past surveys have shown that there is still sufficient spawning habitat available, but poor recruitment may be related to other problems (e.g. lack of deepwater summer habitat, illegal harvest).

It is recommended that total harvest be limited to 200 kg (500 lbs)/yr with the objective of maintaining lake trout populations in all three basins as high quality/trophy angling fisheries.

Other Species

Lake whitefish were reduced from former levels of abundance in this area by overfishing and the loss of traditional spawning areas, due to increased water levels in the late 1800s. Current harvests, primarily from the commercial fishery, averaged 14,000 kg (30,800 lbs)/yr which were below the potential yield estimate of 22,200 kg (48,900 lbs)/yr. Populations have gradually recovered in response to controls on harvest. Assessment netting has indicated a long-term increase in abundance with up to 10 age groups and fish as old as age 14 present in recent catch samples. Mortality, growth, and maturity rates are within the normal range for this species on Lake of the Woods. The management objective had been set at 11,100 kg (24,400 lbs)/yr or 50% of the potential yield since it was not known what impact the recent introduction of rainbow smelt would have on this species. Lake whitefish

have declined in several Ontario lakes following smelt introductions, due to increased competition and direct predation (Evans *et al.* 1987). Since *whitefish populations appear to be sustainable* at current levels of exploitation, it is recommended that the management objective be adjusted upward to 16,700 kg (36,700 lbs)/yr. Catches will be closely monitored with a view to further increasing the management objective if population indices continue to improve.

Black crappie (Figure 15 and 16) and **muskellunge** (muskie) are targeted species in this sector. Their distribution is restricted to localized areas which provide suitable habitat. Recent creel surveys have indicated that the combined yield of these species constitutes a small part of total fish harvest from this area and is well within sustainable levels. Improvements in muskie populations have occurred in this sector, as in other parts of the lake, over the last two decades. The management objectives for these two species are at the opposite ends of the spectrum. Crappie are managed at 3,300 kg (7,300 lbs)/yr to provide a quantity fishery. The minimum length regulation for muskie angling on Lake of the Woods was increased from 121.9 cm (48 inches) to 137.2 cm (54 inches) in 2001, to recognize the lake's potential to grow extremely large fish and to manage it as a trophy or "record class" fishery.

Ontario-Central Sector

The Central Sector covers 40,300 ha (99,500 acres) and has a potential fish yield of 4.24 kg/ha/yr (3.82 lbs/acre/yr) or 171,000 kg (376,200 lbs)/yr. Fish populations are harvested primarily by non-residents of Canada: anglers from resorts in Sioux Narrows, Kenora, and the Northwest Angle in Minnesota, and non-resident property owners. Local resident anglers from the Kenora-Keewatin and Sioux Narrows areas also fish this sector. The winter fisheries in the North and Central sectors, comprised almost entirely of local residents, have expanded dramatically since the early 1990s, and presently account for 12 to 15% of total annual effort and harvest per sector. Although all non-First Nations commercial licences have been retired, commercial and subsistence fishing by First Nations communities continue in this sector.

Walleye

Walleye harvest in this sector averaged 49,300 kg (108,500 lbs)/yr which was 25% above the potential yield level of 39,300 kg (86,500 lbs)/yr (Figures 5 and 6). Since the 1998 Atlas revision, all non-First Nations commercial fishing licences have been retired, and walleye daily catch and possession limits for both Canadian and non-

Canadian anglers have been reduced. Even with these changes, the average annual walleye harvest remained the same as the 1998 Atlas estimate. However, the angling regulation changes that reduced the daily catch limit for non-Canadian anglers from six (6) fish per day to two (2) with four (4) in possession and only one (1) over 46 cm (18 inches)), probably prevented the magnitude of harvest that occurred in the North Sector.

Recent assessments indicated that walleye abundance has remained relatively stable since the late 1980s. Although there has been a slight shift towards younger fish and a corresponding decline in walleye older than age 5, a good distribution of mature females over a number of age groups remained within the spawning population. Observed rates of growth, maturity and total mortality were fairly rapid, and are indicative of heavily fished walleye populations in northern Ontario. The management objective of 34,200 kg (75,200 lbs)/yr reflects the intent to reduce current harvest levels, in order to manage for long-term stability and a quality walleye fishery in this sector. This may require additional management intervention (e.g. regulation).

Northern Pike

In contrast to walleye, northern pike harvest which averaged 5,300 kg (11,700 lbs)/yr has dropped dramatically from the 1998 Atlas estimate (14,400 kg or 31,700 lbs/yr). This decrease can be attributed to a reduction in commercial fishing activity in this sector since 1996. Average harvest for the 1997–2002 period was well within the potential yield estimate (Figures 7 and 8) of 34,200 kg (75,200 lbs)/yr, and the management objective of 17,100 kg (37,600 lbs)/yr for this species. Recent assessments indicated that pike populations have improved in this sector, with a shift to larger and older fish, full representation of age groups from two to 11 years, and fish as old as 16 years. This was also supported by an increase in the age at maturity for both males and females, and a decline in total mortality, likely in response to a drop in commercial fishing for this species. It is recommended that northern pike continue to be managed at a level well below its current potential yield estimate, in order to maintain long-term stability and a quality northern pike fishery. A management objective of 17,100 kg (37,600 lbs)/yr which is 50% of the potential yield estimate reflects this intent.

Smallmouth/Largemouth Bass

Both largemouth and smallmouth bass are found in the Central Sector, although smallmouth bass are more widely distributed. The current

bass harvest which averaged 1,400 kg (3,100 lbs)/yr was well within the potential yield estimate of 29,100 kg (64,000 lbs)/yr and the management objective of 7,300 kg or 16,000 lbs/yr (Figures 9 and 10). The management objective supports the intent to manage for quality bass fisheries. Although the average size of bass in index gill net catches has increased over the long term, the relative abundance has declined, especially since 1990–91. Age groups up to 14 years were represented in both angling and assessment catches.

Sauger

Annual sauger harvests averaged 2,300 kg (5,100 lbs)/yr which was 50% below average harvest estimates in the 1998 Atlas. The buy-out of non-First Nations commercial fisheries in this sector since 1996 could account for this decrease. Current harvest levels were well below the potential yield estimate of 12,000 kg (26,300 lbs)/yr for this species (Figures 11 and 12). As in other parts of the lake, sauger abundance in the Central Sector declined in the early 1990s. Recent assessments indicated a recovering population with age groups up to age 14 represented, and an increased contribution of several strong year-classes. Growth and maturity rates have remained stable over the long term. The management objective for this species has been set at 10,200 kg (22,400 lbs)/yr, slightly below the potential yield estimate, with the intent of managing for continued recovery and long-term stability in the event of wide natural fluctuations in abundance.

Yellow Perch

Yellow perch annual harvests averaged 2,800 kg (6,100 lbs)/yr which was well below the potential yield estimate and management objective of 5,100 kg (11,300 lbs)/yr (Figures 13 and 14). Perch harvest declined by over 60% when compared with the 1998 Atlas estimates, largely owing to a decrease in commercial fishing for this species. Recent assessments have indicated that populations exhibit a broad range of age and size class distributions, and growth/maturity rates which are comparable to those of lightly harvested populations. The management objective for yellow perch is to manage at the potential yield level for a quantity fishery.

Other Species

Lake whitefish are caught in this sector, primarily by the commercial fishery during fall, winter, and early spring. Average annual harvests have increased from about 6,100 kg (13,400 lbs)/yr in 1990–1996 to 10,900 kg (23,900 lbs)/yr

during 1997–2002, as the result of increased commercial fishing for this species. The potential yield and management objective were set at 5,100 kg (11,300 lbs)/yr to reflect the limited amount of well-oxygenated, deepwater summer habitat available to whitefish in this sector. Further studies are required to determine if harvested fish are year-round residents or seasonal migrants from other sectors. A seasonal movement of whitefish back into nearby Whitefish Bay probably occurs during late spring/early summer. The extent and regularity of these movements are unknown.

Both **black crappie** and **muskellunge** are not widely distributed in this sector, but occur in localized areas which provide suitable habitat. Black crappie annual harvests averaged 900 kg (1,900 lbs)/yr which was well below the potential yield estimate and management objective of 5,100 kg (11,300 lbs)/yr (Figures 15 and 16). Muskellunge populations in this sector have responded favourably to increased catch and release by anglers.

Ontario–Whitefish Bay

Whitefish Bay covers 20,600 ha (50,900 acres) and is the least productive of all parts of Lake of the Woods. It has a potential yield of 2.82 kg/ha (2.51 lbs/acre) or 58,100 kg (127,800 lbs)/yr. This sector is intensely fished by anglers, primarily non-resident guests of the numerous tourist resorts in the Sioux Narrows–Nestor Falls area and, to a lesser extent, by resident anglers and subsistence harvesters. Local First Nations fish commercially in the Regina–Lobstick Bay area. Three First Nations and associated lands are located directly in this sector.

Walleye

Walleye are most abundant in the shallower, more productive waters of Snake Bay, Knickerbocker, and the southern portion of Whitefish Bay. Populations are limited by the availability of good spawning grounds adjacent to suitable habitat for early rearing. The average annual walleye harvest, estimated at 8,400 kg (18,400 lbs)/yr, was within the potential yield estimate of 11,600 kg (25,500 lbs)/yr but exceeded the management objective of 5,800 kg (12,800 lbs)/yr (Figures 5 and 6). Walleye harvests have increased from the 1998 Atlas estimates (5,100 kg or 11,300 lbs/yr). This can be attributed to strong year-classes and improved angling success. Recent assessment of walleye spawning populations, along with both index (test) net and angling catches, indicated full representation of all age groups up to 17 years old and a broad distribution of size classes, especially fish greater

than 45 cm (18 inches) in length. Both maturity and mortality rates were within the normal range for this species. Rapid growth rates reflect an abundant food supply and the potential to produce trophy sized fish. Spawning populations had a high diversity of contributing age groups, especially amongst female spawners. A management objective of 5,800 kg (12,800 lbs)/yr or 50% of the potential yield estimate confirms the intent to manage walleye as a quality fishery in this coldwater basin.

Northern Pike

The average annual northern pike harvest of 14,600 kg (32,200 lbs)/yr was slightly above the potential yield estimate of 13,400 kg (29,500 lbs)/yr (Figures 7 and 8). However, it exceeded the management objective of 5,800 kg (12,800 lbs)/yr which was established in the 1998 Atlas. Unlike the North and Central sectors which showed a decrease in northern pike harvest, Whitefish Bay harvest increased from the last reporting period, even with the more restrictive daily catch and size restrictions that were introduced in 1999. This illustrates the importance of northern pike for food rather than as a trophy species in this sector. Recent assessments based on index (test) gill net, angling creel and spring spawning trap net catches indicated good representation of all age groups up to age 13. Although growth rates were rapid and the potential exists for producing large pike, the representation of fish larger than 70 cm (27.6 inches) in assessment catches was limited. Higher mortality and earlier maturity reflect greater fishing pressure on this species than in less exploited pike populations in other sectors. The management objective for this sector has been revised upward from the 1998 Atlas to 13,400 kg (29,500 lbs)/yr which equals the potential yield. The intent is to manage pike as a quantity rather than a quality fishery, in order to direct fish consumption away from lake trout which is being managed as a trophy species.

Smallmouth/Largemouth Bass

Both largemouth and smallmouth bass are found in Whitefish Bay, although the latter are more widely distributed. The average annual harvest of bass was estimated at 4,700 kg (10,400 lbs)/yr, which was well within the potential yield estimate (Figures 9 and 10) of 9,900 kg (21,700 lbs)/yr but above the management objective of 2,500 kg (5,400 lbs)/yr. More bass were kept for food by Whitefish Bay anglers than in other areas of the lake. Populations were stable with a broad range of age and size classes present in both angling and index (test) gill net catches.

All age groups up to age 12 and quality sized fish greater than 40 cm (16 inches) were well represented. Growth, maturity, and total annual mortality rates were similar to bass populations in the other sectors. The management objective was set at 25% of the maximum sustainable yield, and reflects the intent to manage for a quality bass fishery in this sector. Monitoring of local bass tournaments should provide additional information to assess bass angling quality.

Lake Trout

Whitefish Bay represents the largest coldwater basin and lake trout area on Lake of the Woods. Here, lake trout are intensely angled during both winter and openwater seasons, primarily by non-residents through the local tourism industry. Long-term monitoring of the angling fishery and spawning populations in this area had shown that older age and larger size classes of lake trout were rapidly being reduced by increasing angling pressure. In an effort to stop the decline in angling quality and maintain/increase trophy lake trout fishing opportunities in this area, special lake trout regulations were introduced on Whitefish Bay in 1990. Current estimates place the annual lake trout harvest at about 10,900 kg (24,000 lbs)/yr which is slightly below the potential yield estimate of 11,600 kg (25,600 lbs)/yr. Recent assessments have indicated that the number of spawning age groups and survival within spawning populations has increased. The fishery has yet to produce more trophy sized fish, but anglers report improved catch rates. To date, trophy lake trout regulations have been successful in reducing annual harvests to within sustainable levels without a decline in angling effort. However, annual harvest has not been reduced to the trophy management objective (5,800 kg or 12,800 lbs/yr). Additional management initiatives will be required, pending consultation with anglers and the public.

Other Species

Both **yellow perch** and **sauger** are present in Whitefish Bay but sauger abundance is limited by clear waters which are not favoured by this species. Yellow perch harvests averaged about 1,000 kg (2,100 lbs)/yr which was below the potential yield and management objective of 1,500 kg (3,200 lbs)/yr (Figures 13 and 14).

Lake whitefish abundance was considerably reduced by overfishing during the 1950s. The current potential yield estimate and management objective have been set at 5,800 kg (12,800 lbs)/yr, in order to reflect the relative abundance of this species in recent index gill net catches. It is suspected that a portion of this stock is exploited

by the commercial fishery during seasonal movements into the Central Sector in the fall and winter (see Central Sector discussion). An average annual harvest of about 6,600 kg (14,600 lbs)/yr was taken almost entirely by the subsistence and commercial fisheries. Recent assessments indicated that populations were slow growing, late maturing, and comprised of a high percentage of older fish up to 24 years old. Since rainbow smelt were first observed in Whitefish Bay in 1999, it is not known what long-term impact they will have on whitefish populations in this area.

Black crappie and **muskellunge** are limited to areas of favourable habitat within Whitefish Bay. At present, annual harvests of these species are within sustainable levels. The average annual harvest of black crappies was estimated at 1,400 kg (3,100 lbs)/yr which was below the potential yield and management objective of 1,700 kg (3,800 lbs)/yr (Figures 15 and 16).

Ontario-Sabaskong Bay

This sector, which includes Obabikon Lake, Sabaskong, Burrow, and Obabikon bays, has a total surface area of 18,200 ha (45,000 acres), a potential fish yield of 4.92 kg/ha/yr (4.38 lbs/acre/yr) or 89,600 kg (197,100 lbs)/yr. Sabaskong Bay has the most productive waters in Lake of the Woods, and experiences the heaviest angling pressure at over 12 angler-hr/ha/yr. The majority of anglers are non-residents of Canada who are guests of tourist resorts in the Nestor Falls, Morson, and Hanson Bay area. Although only one First Nation community is on Sabaskong Bay, reserve lands held by other First Nations and Treaty 3 are located throughout this sector. Subsistence and commercial fishing also occur in this area.

Walleye

Annual walleye harvests from Sabaskong Bay averaged 20,200 kg (44,600 lbs)/yr, slightly below the potential yield estimate of 20,600 kg (45,300 lbs)/yr (Figures 5 and 6). Average annual harvests increased by over 68% from the 1990-96 period, likely in response to improved angling success and several strong year-classes in the fishery. Based on the predominance of non-resident anglers in this area, it is believed that the new (1999) non-resident regulations prevented the angling harvest from exceeding potential yield. Walleye in Sabaskong Bay remain heavily exploited, as evidenced by status indicators from recent assessment netting. Catches were dominated by small, young fish (ages 1 to 5 years), with few older than age 9 and longer than 50 cm (19.7 inches). Total mortality rates, especially

for females, were high relative to other sectors. However, the diversity of age groups amongst female spawners remains adequate to ensure a sustainable fishery. Both growth and maturity rates were within the normal range for this species in Lake of the Woods. This would appear to be an intermediate density walleye population based on fall walleye index netting (FWIN; Morgan 2002) and fish community index gill netting results. The management objective of 20,600 kg (45,300 lbs)/yr, which has been set at the full potential yield level, reflects the intent to manage this species as a quantity fishery, and to provide opportunities for subsistence, commercial, and angling fisheries.

Northern Pike

Average annual harvest of northern pike from Sabaskong Bay was estimated at 8,100 kg (17,800 lbs)/yr, well within the potential yield estimate (Figures 7 and 8) of 22,400 kg (49,300 lbs)/yr. The current average harvest estimate represented a 96% increase over the 1990–96 average (4,100 kg/yr). This can be attributed to an increase in harvest by non-resident tourist anglers, despite the 1999 reduction in daily catch/possession limits and more restrictive size limits for pike. Current assessments have indicated good representation of fish up to 80 cm (32 inches) in length and age 10. Relatively few older and larger fish were present. Growth and maturity rates were rapid, but still within the normal range for Lake of the Woods populations. A management objective of 22,400 kg (49,300 lbs)/yr, equal to the potential yield, supports the intent to manage this species for a quantity fishery, allowing for subsistence, commercial fishing, and angling opportunities.

Smallmouth/Largemouth Bass

Both smallmouth and largemouth bass are widely distributed in this sector. The average annual bass harvest, which increased from 1,700 kg (3,800 lbs)/yr in the 1998 Atlas to 2,900 kg (6,300 lbs)/yr, is still within the potential yield (Figures 9 and 10) of 12,600 kg (27,600 lbs)/yr for these species. Based on limited samples from assessment nets, age and size classes were well represented, although few fish older than age 9 and larger than 40 cm (15–16 inches) were present. Growth and maturity parameters were within the range for bass in Lake of the Woods. A management objective of 3,100 kg (6,900 lbs)/yr reflects the intent to manage this fishery for quality angling opportunities.

Sauger

The average annual harvest of sauger was estimated at 1,900 kg (4,200 lbs)/yr, below the

potential yield estimate of 6,300 kg (13,800 lbs)/yr (Figures 11 and 12). Sauger abundance in assessment index net catches from this sector decreased during the early 1990s. This trend paralleled a similar decline in sauger populations throughout Lake of the Woods, despite the fact that sauger had been lightly exploited in Sabaskong Bay in the past. Age groups up to age 7 were well represented, but few older fish were caught during recent assessments. Growth and maturity rates were rapid when compared to populations in other parts of the lake. Several strong year-classes have been produced in recent years and should contribute to population recovery. Harvest will be managed at 5,300 kg (11,700 lbs)/yr, slightly below the potential yield level, to support continued improvement and long-term stability.

Yellow Perch

Yellow perch harvests averaged 3,100 kg (6,900 lbs)/yr during 1997–2002, which was above the potential yield estimate of 2,700 kg (5,900 lbs)/yr (Figures 13 and 14). An increase in average harvest over the 1998 Atlas estimate of 1,200 kg (2,700 lbs)/yr can be attributed to a greater angling harvest of this species, especially during winter when perch are taken incidentally by the crappie fishery. Yellow perch populations have remained relatively stable over the long term, with representation of all age groups up to age 11. Quality sized perch greater than 23 mm (9 inches) in length comprised 8 to 10% of assessment catches. The objective is to manage yellow perch as an experimental fishery, in order to encourage maximum economic benefits while maintaining a sustainable population. The management objective will be set at 6,400 kg (14,000 lbs)/yr, exceeding the potential yield estimate of 2,700 kg (5,900 lbs)/yr. The stock will be monitored during this period and harvest levels will be adjusted accordingly.

Black Crappie

Although black crappies are an introduced species, they have become a major component of the fish community in Sabaskong Bay. Recent assessments have confirmed that the habitat of Sabaskong Bay is more suited to centrarchid (sunfish) species than previously reported. The potential yield estimate for crappies has been set at 22,700 kg (50,000 lbs)/yr (Figures 15 and 16), based on the average annual yield during 1992–2002. Current average annual harvest was estimated at 28,300 kg (62,200 lbs)/yr, up from the 1998 Atlas estimate of 17,000 kg (37,400 lbs)/yr. Annual fluctuations in crappie abundance

can be attributed to production of strong year-classes which occur at regular intervals. The winter angling fishery, which occurs near Nestor Falls and Hay Island, can account for 70 to 90% of the total harvest in any year. The daily catch and possession limit for crappies was reduced from 30 fish to 15 fish per day in 2000. It is not yet known what effect this has had on the fishery. A management objective for crappies has been set at the potential yield level of 22,700 kg (50,000 lbs)/yr with the intent to manage as a quantity fishery for subsistence, angling, and commercial fishing.

Other Species

Sabaskong Bay is one of the prime muskellunge angling areas on Lake of the Woods. Angling for this species accounts for over 10% of all openwater angling effort on Sabaskong Bay. The muskie harvest rate has declined from between 30 to 40% during the early 1980s to less than 1% in 2002, largely as the result of increased catch and release by anglers and increases in the minimum size limit regulation. The management objective is to manage this species for a high-quality/trophy fishery.

Ontario-South Sector 5

This sector covers 71,800 ha (177,300 acres) and extends south of the Aulneau Peninsula from Miles Bay to the mouth of the Rainy River. It has an estimated potential fish yield of 4.25 kg/ha/yr (3.78 lbs/acre/yr) or 305,000 kg (671,000 lbs)/yr. Most harvesting occurs through the commercial net fishery. However, other harvesters include subsistence fishers, local residents, and non-resident anglers out of tourist resorts in the Morson, Nestor Falls, and Rainy River areas. Three First Nations communities and reserve lands are located in this sector. The Rainy River fishery is included as part of South Sector 5, with respect to potential yield, average annual harvest estimates, and management objectives.

Walleye

The potential yield estimate for walleye in Sector 5 (Figures 5 and 6) is 64,000 kg (140,900 lbs)/yr. In the 1998 Atlas, the walleye population had been assessed as in decline and a management objective of 42,700 kg (94,000 lbs)/yr was recommended, in order to facilitate recovery. The average annual walleye harvest was reduced from 56,800 kg (125,000 lbs)/yr to 33,200 kg (73,100 lbs)/yr, primarily through retirements of non-First Nations commercial quotas and licences. Recent assessment data (2001/2002) have indicated that walleye populations in this

sector have improved since the last Atlas reporting period (1990–96). There has been an increase in overall abundance and in the mean catch of older, mature fish in both regular index (test) gill net and FWIN gill net catches. Age groups from zero to 10 years old were well represented, and fish as old as age 15 were found in catch samples. Although maturity rates have increased slightly, total mortality rates for males (46%) and females (36%) were high when compared to populations in other sectors and northwestern Ontario lakes (Morgan *et al.* 2003). Indices based on the diversity of age groups among female spawners and on the abundance of mature females in the population remain below healthy levels. In order to continue recovery, a management objective of 45,500 kg (100,000 lbs)/yr is recommended. Once the population has fully recovered, the long-term management objective for walleye is to manage for a quantity fishery and provide for subsistence, commercial fishing, and angling opportunities.

Northern Pike

Although the potential yield estimate for northern pike is 61,000 kg (134,200 lbs)/yr (Figures 7 and 8) for this sector, the management objective for the 1998 Atlas was set at 45,800 kg (100,700 lbs)/yr. Past assessments indicated that the population had declined and a lower management objective was required to facilitate stock recovery. The average annual pike harvest, which was estimated at 10,400 kg (22,900 lbs)/yr during 1997–2002, was caught primarily by the commercial and subsistence fisheries. Recent assessments indicated that recovery has been slow and populations have not responded to a decrease in exploitation, as quickly as in other sectors. Age and size class distributions were limited to fish younger than age 10 and 50–70 cm (19.7–27.6 inches) in length. Quality sized fish, longer than 70 cm (27.6 inches), comprised less than 25% of index net catch samples. Mortality rates were high and maturity rates were rapid when compared to populations in nearby sectors. A management objective of 45,800 kg (100,700 lbs)/yr reflects the intent to continue to manage northern pike in this sector at below the potential yield level, and to closely monitor populations for improvements in abundance and age class structure.

Smallmouth/Largemouth Bass

Bass have been assigned a lower partitioned yield (8% of the total potential yield estimate) than in other Ontario sectors since large portions of South Sector 5 lack preferred spawning and rearing habitat for these species. Broad distributions of age and size classes were present

in recent index net and angling catch samples. Growth rates were slightly slower than those observed for bass in other sectors, but maturity rates were similar. Populations appear to be healthy although not widespread. Largemouth bass are not common to this sector. The average annual bass harvest of 1,100 kg (2,400 lbs)/yr, was well within the revised management objective (Figures 9 and 10) of 6,100 kg (13,400 lbs)/yr. The intent is to manage both smallmouth and largemouth bass as quality fisheries in this sector.

Sauger

The potential yield estimate for sauger in South Sector 5 is 21,400 kg (47,000 lbs)/yr (Figures 11 and 12). The management objective in the 1998 Atlas was set at 15,300 kg (33,600 lbs)/yr, in order to facilitate a recovery of this stock. Overharvest contributed to a decline in abundance and older age/size classes in this sector. Natural fluctuations in abundance also appear to be characteristic of sauger in Lake of the Woods. Since 1997, management initiatives have reduced the average annual harvest from about 44,100 kg (97,000 lbs)/yr to 14,300 kg (31,400 lbs)/yr during 1997–2002. Most of these fish were caught by the commercial fishery. Recent assessments have indicated that stock status has improved, with an increase in abundance and a broadening of age/size class distributions. Age groups 0 to 10 years old were well represented, but older fish were largely absent. Although maturity rates have stabilized, growth remained rapid and total mortality rates (48%) were high when compared to those of sauger in other sectors. A management objective of 18,200 kg (40,000 lbs)/yr is recommended, in order to support further recovery and long-term stability. Sauger will continue to be managed as a quantity fishery providing subsistence, commercial fishing, and angling opportunities.

Yellow Perch

The annual harvest of yellow perch from this sector averaged 17,100 kg (37,600 lbs)/yr, which was above the potential yield estimate of 15,300 kg (33,600 lbs)/yr for this species (Figures 13 and 14). Perch are primarily harvested by the commercial fishery. Although recent assessment data identified a decline in overall abundance, numbers of fish larger than 23 cm (9 inches) have increased since 1990–1996. Both the mean age and the number of age/size classes in index and FWIN gill net catches have increased. Yellow perch are managed as a quantity fishery for both subsistence and commercial fishing in this sector. The management objective of 15,300 kg (33,600 lbs)/yr equals the potential yield estimate.

Other Species

The distributions of **black crappie** and **muskellunge** in South Sector 5 are limited to pockets of suitable habitat.

The combined commercial, subsistence and angling harvest of **black crappie** from this sector averaged about 10,200 kg (22,500 lbs)/yr during 1997–2002, well within the potential yield estimate of 15,300 kg (33,600 lbs)/yr (Figures 15 and 16). Although populations appeared to be healthy, wide fluctuations in annual harvest occur in response to a natural cyclical pattern of abundance for this species. A management objective of 15,300 kg (33,600 lbs)/yr reflects the intent to manage this species as a quantity fishery at the potential yield level, allowing for subsistence, commercial, and angling opportunities.

Muskellunge are managed for a quality/trophy fishery in this sector, under the same 137 cm (54 inches) minimum length limit as other Ontario portions of the lake. Although **lake whitefish** are caught occasionally by the commercial fishery, this species is not common in this sector since preferred habitat is limited.

Lake Sturgeon

The average annual harvest of lake sturgeon was 500 kg (1,000 lbs)/yr, well below the potential yield estimate of 3,000 kg (6,600 lbs)/yr (Figure 17). This represented a significant decrease from 2,500 kg (5,400 lbs)/yr for the 1990–1996 reporting period. Subsistence fishing by the Rainy River First Nation currently accounts for all of this harvest. The non-First Nations commercial fishery was retired in 1995 and the Rainy River First Nation has voluntarily, ceased commercial fishing while the stock recovers. Angling harvest in Ontario waters is minimal although interest in lake sturgeon as a sport species is increasing. The Ministry will be looking at a number of options to regulate lake sturgeon angling in the near future.

A Rainy River First Nation sturgeon hatchery was established in 1992–93, with support from Ontario Hydro. This hatchery and cage culture facility produced fish originating from Rainy River brood stock, and resulted in the stocking of 5,000 or more young-of-the-year (YOY) and approximately 40 to 80 sub-adult sturgeon in the fall of 1997. OMNR, along with the First Nation, completed a fisheries and aquatic habitat inventory on a number of tributaries to the Rainy River in 1997. A Rainy River First Nation Resource Stewardship Framework, funded through the Ontario Living Legacy Trust, allowed the First Nation to conduct further habitat and impact assessments along the Rainy River and its tributaries. One of these studies specifically

investigated immature lake sturgeon habitat use on the Rainy River and two tributaries.

The management objective of 1,900 kg (4,200 lbs)/yr for South Sector 5 and the Rainy River combined reflects the intent to manage this species for continued rehabilitation along with limited subsistence harvest.

Ontario—South Sector 6

South Sector 6 covers 42,000 ha (103,800 acres) and has a total potential fish yield estimate of 4.0 kg/ha/yr (3.56 lbs/acre/yr) or 168,000 kg (369,600 lbs)/yr. This sector extends from Monument Bay, Tug Channel and Sabaskosing Bay, south to the north shore of Big Island, including Little Traverse Bay. It is primarily fished by First Nations subsistence and commercial fishers. Two First Nations communities are located in this sector, but other reserve lands occur throughout this area. Non-resident of Canada anglers who stay at Minnesota-based resorts in the North West Angle—Oak Island area and at resorts on the Ontario side in South Sector 6 are the other main sources of harvesting. Minnesota-based angling use of this sector has increased since 1999. Resident angling is minimal.

Walleye

The average annual harvest of walleye which was estimated at 38,900 kg (85,600 lbs)/yr exceeded both the potential yield estimate of 35,300 kg (77,600 lbs)/yr (Figures 5 and 6) and the average annual harvest estimate of 34,900 kg (76,800 lbs)/yr from the 1998 Atlas. This moderate harvest increase can be attributed to the commercial fishery and to a lesser extent, subsistence harvesting. Long-term improvements in walleye stock status have continued, although this still remains a heavily exploited fishery. Age and size class distributions from index netting and creel catch samples have broadened to include all age groups up to age 12 and fish as old as 14 years. Both the abundance of mature fish and the diversity of age groups among female spawners indicate a healthy, stable spawning population. A decline in mean age and an increased proportion of younger fish in index net catches can be attributed to recruitment of several strong year-classes in recent years. Total annual mortality (31%) has continued to decline, although both growth and maturity rates have remained constant since the 1998 Atlas reporting period. The management objective has been set at 33,600 kg (74,000 lbs)/yr, in order to manage this species as a quantity fishery, and provide subsistence, commercial fishing, and angling opportunities.

Northern Pike

Northern pike harvests have averaged 7,700 kg (17,000 lbs)/yr since 1997, which was well within the estimated potential yield of 33,600 kg (73,900 lbs)/yr (Figures 7 and 8). Recent assessment has indicated that stocks are healthy with up to 11 age groups and fish as old as 14 years represented. Quality sized pike, larger than 70 cm (27.6 inches), comprised 45% of index net samples from this sector. This species will be managed as a quantity fishery, with a management objective set at the potential yield level of 33,600 kg (73,900 lbs)/yr.

Smallmouth/Largemouth Bass

The average annual harvest of bass (1,100 kg or 2,500 lbs/yr) was well below the potential yield estimate of 20,700 kg (45,600 lbs)/yr for this species (Figures 9 and 10). Largemouth bass have expanded their range to occupy areas of suitable habitat in this sector. Bass populations appeared to be stable and to offer good angling opportunities. The management objective has been set at 5,200 kg (11,400 lbs)/yr, with the intent to manage this species as a quality fishery.

Sauger

The potential yield estimate for sauger in this sector is 11,800 kg (25,900 lbs)/yr (Figures 11 and 12). The management objective in the 1998 Atlas was set at 8,400 kg (18,500 lbs)/yr, in order to address a decline in sauger populations during the early 1990s. Sauger harvests, attributed mainly to the commercial fishery, averaged 8,500 kg (18,600 lbs)/yr during 1997–2002. Sauger populations were showing signs of improvement during recent assessments of this sector. Age and size class distributions have broadened with up to nine age groups and fish as old as age 12 present. Overall abundance in index (test) nets has increased, including quality sized fish larger than 30 cm (11.8 inches). A management objective of 10,100 kg (22,200 lbs)/yr has been adopted, in order to allow for continued recovery and to ensure stability in the event of natural fluctuations in population abundance. The long term management objective will be to manage sauger as a quantity fishery and to provide subsistence, commercial fishing, and angling opportunities.

Yellow Perch

The potential yield estimate for yellow perch is 8,400 kg (18,500 lbs)/yr for South Sector 6 (Figures 13 and 14). The average annual perch harvest almost tripled from 10,000 kg (22,000 lbs) during 1990–96 to 29,500 kg (64,800 lbs)/yr for the current (1997–2002) reporting period, largely

as the result of increased commercial harvest. Assessments since the 1998 Atlas indicated a slight decline in overall abundance, although numbers of quality sized perch larger than 23 cm (9 inches) have increased. Both mean age and size of perch also increased. Faster growth and a slightly higher total mortality rate (47%) were observed. These increases likely reflect longer growing seasons and increased exploitation during recent years. Population modelling using current parameters has predicted that annual yields above the current potential yield level can be sustained by this fishery. The management objective has been set at 18,500 kg (40,800 lbs)/yr, in order to manage this species as an experimental fishery over the next six-year reporting period. Commercial harvests will be closely monitored, with a view to revising the potential yield estimate if population indicators suggest that annual harvests are sustainable.

Black Crappie

The average annual harvest of black crappie was estimated at 6,700 kg (14,700 lbs)/yr, well within the potential yield estimate of 8,400 kg (18,500 lbs)/yr for this species (Figures 15 and 16). Commercial harvesting accounted for approximately 90% of the harvest, while the remainder was taken by subsistence and angling. Stock status parameters indicated that populations were healthy but black crappie are prone to the same wide fluctuations in abundance as observed in other sectors. The management objective of 8,400 kg (18,500 lbs)/yr, which has been set at the potential yield estimate, reflects the intent to manage this species as a quantity fishery.

Other Species

Muskellunge are one of the major sport species in Sector 6 and currently account for 16 to 20% of all angling effort. As in other parts of the lake, muskellunge populations in this sector have responded favourably to increased "catch and release" angling practices and an increase in minimum length regulations. This species will continue to be managed as a quality/trophy fishery.

Lake whitefish are occasionally caught by commercial and subsistence fisheries in this area, but their numbers are limited by the availability of well-oxygenated, deepwater summer habitat. It is suspected that most whitefish captured in this area are migrants from Whitefish Bay. Although the annual harvest has averaged 2,700 kg (5,900 lbs)/yr, OMNR has increased quotas to an experimental winter commercial fishery. OMNR will closely monitor catches to determine a sustainable

harvest level for this sector. This fishery is being managed to provide a quantity fishery and a range of harvesting opportunities.

Ontario-Shoal Lake

Although Shoal Lake is a separate and distinct water body, it is considered to be part of Lake of the Woods for management purposes. Shoal Lake covers 25,900 ha (64,000 acres) and has a potential fish yield of 4.26 kg/ha/yr (3.79 lbs/acre/yr) or 110,335 kg/yr (242,560 lbs/yr). Two First Nations communities are located on its shores, and other First Nations have reserve lands in this area. In the past, Shoal Lake was intensely fished by: five commercial operations; subsistence harvesters; and anglers composed of non-resident cottagers, non-resident guests at nearby resorts, and local residents. Fish populations, especially walleye, were overexploited to the point of collapse. This prompted the closure of the walleye fishery to both commercial fishing and angling, along with restrictions on the use of gill nets. Since these measures were imposed in May 1983, the walleye fishery remains closed. Subsistence fishing by the First Nations communities continues to occur. With improvements in the stock status of other species, there has been a resurgence in angling by non-resident cottagers, non-resident guests at Lake of the Woods tourist facilities, and local residents in the Kenora and Shoal Lake First Nations communities. Commercial fishing by First Nations for species other than walleye is occurring.

Walleye

This sector was one of the most productive for walleye, as evidenced by the extent of past harvest levels. Between 1960 and 1983, commercial catches alone exceeded the potential yield estimate of 33,100 kg (72,800 lbs)/yr (Figure 5) in 17 of 24 years, and by up to 650% in a single year (1977). The angling harvest was estimated at about 18,200 kg (40,000 lbs)/yr during this period. By 1982, numbers of mature fish had been greatly reduced, and walleye stocks were composed primarily of a single 1979 year-class. In an effort to protect these last potential spawners, both commercial fishing and angling for walleye were closed in May 1983.

An independent fisheries assessment by the Ontario/Anishabiki Fisheries Resource Centre, as part of the Shoal Lake Watershed Management Plan, has confirmed that the walleye population is slowly rebuilding, but it has not fully recovered from past overharvesting. Walleye abundance remains low, and the population is dominated by young, early-maturing, fast-growing individuals.

Although numbers of older fish are low, 13 age classes were present in recent catches. In contrast to the 1980s when spawning success was intermittent, most year-classes since 1992 are represented in the population and successful reproduction is occurring annually.

The average annual subsistence harvest has been estimated at 4,500 kg (9,900 lbs)/yr. However, any harvesting continues to retard the recovery of the walleye fishery. As a result, the management objective for walleye on Shoal Lake is zero harvest.

Northern Pike

The average annual commercial harvest of northern pike, estimated at about 1,000 kg (2,100 lbs)/yr during 1997–2002, was well within the potential yield estimate of 27,600 kg (60,700 lbs)/yr (Figure 7). Although survey data are not available, annual harvests of northern pike by angling and subsistence fisheries were considered to be minimal. Northern pike populations that were heavily exploited prior to the walleye fishery closure in 1983 have rebounded. The abundance of northern pike in index (test) nets has doubled along with the number of older age and larger size classes. Up to 12 age groups and fish as old as 14 years were present in recent catch samples. Growth and maturity rates, which had increased dramatically in response to exploitation stress, have decreased in recent years, indicating a return to greater stability within this population. The management objective for northern pike in Shoal Lake is to manage for a quality fishery by maintaining harvests below 13,800 lbs (30,400 lbs)/yr or 50% of the potential yield.

Smallmouth/Largemouth Bass

Both smallmouth and largemouth bass are found in Shoal Lake, although smallmouth is the more abundant of the two bass species. Bass are an important component of the fish community, and their numbers have increased following the walleye population decline. Their importance as a sport species has increased in recent years and they are the focus of competitive tournaments organized by the local First Nations communities.

Although creel survey data are unavailable, annual angling harvests are thought to represent less than 10% of the potential yield estimate (Figures 8 and 9) for these species (i.e. 18,800 kg/yr or 41,300 lbs/yr). Concerns regarding the selective harvest of large bass and the subsequent loss of each nest's reproductive potential, led to the implementation of catch and release only for bass during the June nesting season. A management objective of 4,700 kg (10,300 lbs)/yr

reflects the intent to manage this species for a quality fishery.

Other Species

The annual commercial harvest of **lake whitefish** averaged about 31,600 kg (69,500 lbs)/yr during 1997–2002, which exceeded the current potential yield estimate of 19,900 kg (43,700 lbs)/yr. Recent assessment netting indicated that the whitefish population was abundant, with a wide representation of age classes (18 year-classes) and a relatively low mortality rate (29%). Both male and female whitefish have a mean age at 50% maturity of seven years, and were fully recruited to the commercial fishery at approximately nine years of age. The mean age of a 1996 commercial catch sample was 13.3 years. It would appear that the average whitefish has several opportunities to spawn before it is removed from the population. Since whitefish populations are healthy and sustaining yields at current exploitation levels, an adjustment to the potential yield estimate and management objective was warranted. It is recommended that the potential yield estimate for whitefish be increased from 19,900 kg/yr to 26,500 kg (58,300 lbs)/yr. This equates to an increase in the partitioned total potential yield estimate from 18 to 24%, the maximum recommended for this species (OMNR 1982). A management objective of 26,500 kg (58,300 lbs)/yr would support the intent to manage for a quantity fishery, providing economic opportunities to the First Nations for commercial and subsistence purposes.

Sauger are not found in Shoal Lake, but yellow perch are abundant. The management objective for **yellow perch** will be to manage for a quantity fishery at the potential yield estimate of 3,300 kg (7,300 lbs)/yr (Figure 13).

As in other parts of Lake of the Woods, both **muskellunge** and **black crappie** have a localized distribution in Shoal Lake. A long term decline in muskellunge populations has paralleled an increase in northern pike abundance in this lake. Muskellunge in Shoal Lake are currently managed as trophy fish under the same 137 cm (54 inches) minimum length regulation as Lake of the Woods. The management objective for black crappie was set at 3,300 kg (7,300 lbs)/yr with the purpose of managing this species as a quantity fishery (Figure 15).

Minnesota–Big Traverse Bay

Minnesota's portion of Lake of the Woods includes all or parts of the Big and Little Traverse bays and Muskeg Bay, with a total area of 128,000 ha (317,000 acres). The Minnesota waters of Lake

of the Woods have an estimated annual yield of 4.79 kg/ha (4.32 lbs/acre), for a total of 620,000 kg or 1,370,000 lbs/yr (MEI; Ryder 1965). The total assigned target harvest for sport fish is 411,600 kg (907,500 lbs)/yr. Individual species yields were estimated using a variety of models, including modifications to the MEI yield partition guidelines, thermal optical habitat area (TOHA; Lester *et al.* 2002), and mean annual safe harvest of historical population estimates. Sport fish populations are harvested exclusively by angling.

Walleye

The walleye target harvest of 204,000 kg (450,000 lbs)/yr for the Minnesota portion of Lake of the Woods was set at the potential yield estimate (Figure 5) and derived from the TOHA model using 1,856 growing degree-days (GDD), 101 mg/l⁻¹ total dissolved solids (TDS), and a secchi depth of 1.4 m, as input variables. Average walleye harvest from Minnesota waters during 1997–2002 was 254,700 kg (560,300 lbs)/yr. Walleye harvests exceeded the target harvest in all years except 1999, when 178,000 kg (392,000 lbs) of walleye were harvested. The highest harvest occurred in 2002, when 395,000 kg (871,000 lbs) were taken.

Sixty-five percent of all walleye harvest occurred during May through September by boats based on Minnesota's south shore of Lake of the Woods and the Rainy River. The winter fishery along the south shore and the Rainy River accounted for 25% of the annual harvest. The remaining 10% occurred during spring and fall on the Rainy River, and during the summer in the Northwest Angle area. Less than 1% of the fishing effort based out of the south shore and Rainy River during summer was directed at Ontario and Manitoba waters. Anglers from the Northwest Angle spent 62% of their effort and harvested 43% of their walleye (4,900 kg or 10,800 lbs) from Ontario waters of Lake of the Woods.

The high harvests of 1997–2002 were the result of an abundant walleye population. The 1991 through 1999 period was one of excellent walleye recruitment. For the nine year-classes that strongly influenced walleye harvest during 1997–2002, three were weak, two were of moderate strength, and four were strong. Walleye harvests will likely remain high for the next several years until weak year-classes produced in 1998, 2000, and 2002 influence the size of the overall walleye population. The influence of these weak year-classes could be offset by the very strong year-class produced in 2001.

None of the six Biological Performance Indicators (Gangl *et al.* 2003) from fall assessment gill netting indicated that walleye populations were

experiencing signs of stress, due to overharvest. Two indicators exceeded thresholds. Electrofishing during the spring spawning run on the Rainy River showed a greater proportion of larger male and female walleye in the stock than there was in 1982. Spring electrofishing also indicated that a smaller proportion of the spawning stock was composed of males than in 1982. This shift in the sex ratio is likely due to the selective harvest of smaller fish, primarily males, following the introduction of maximum size and reduced catch limit regulations on the Rainy River spring fishery in 1999.

MDNR is presently working with local anglers and businesses to assess walleye/sauger regulation alternatives that will reduce harvest.

Northern Pike

The northern pike potential yield was estimated at 121,800 kg (268,000 lbs)/yr. Target harvest has been set below the potential yield, at 45,500 kg (100,000 lbs), in order to manage northern pike as a "trophy" fishery (Figure 7). Pike harvests averaged 21,400 kg (47,000 lbs)/yr during 1997–2002. Seventy-eight percent of this harvest occurred during the winter, when approximately 6% of all anglers targeted northern pike. Peak fishing seasons were the late ice and early ice out periods. Only 1 to 2% of summer openwater angling trips were for this species.

Northern pike have been lightly exploited since implementation of experimental trophy regulations in 1996. The final evaluation of these regulations will be completed in 2006. They will be considered successful if the proportion of trophy pike remains stable or increases, even though angling pressure on northern pike may increase through the period. Depending on evaluation and public comment, the experimental regulation may be dropped, modified or adopted. Over 90% of northern pike anglers interviewed during recent creel surveys supported the trophy pike regulations.

Results from index netting and tagging operations indicated that the population was comprised of a variety of age classes, with 2 to 3% of individuals exceeding 102 cm (40 inches) in length. Fish exhibited good growth and low mortality. Over 5,500 northern pike were tagged during spawning runs in 1995, 1996, and 1997. Tagged northern pike had an estimated annual survival rate of approximately 68%. Anglers harvested about 6% of the pike population annually.

Smallmouth/Largemouth Bass

The potential yield estimate for smallmouth and largemouth bass is 30,500 kg (67,200 lbs)/yr (Figure 9). Annual harvests of smallmouth and largemouth bass rarely exceed 200 kg (500 lbs)/yr from the Minnesota portion of Lake of the Woods. Since habitat for these species is limited in the open expanses of the Big Traverse, it is unlikely that bass will become a significant part of the fish community in this area.

Sauger

The potential yield for sauger, which was estimated at 113,600 kg (250,000 lbs)/yr, represented the average annual safe harvest from 1988–1999. This safe harvest level was estimated from simulation modelling, whereby fishing mortality was set equal to natural mortality ($F=M$). This management strategy produced an exploitation rate of 25% and safe harvests which ranged from 58,000–208,000 kg (127,600–457,600 lbs)/yr during 1988–1999. Target harvest has been set equal to potential yield (Figure 11)

Sauger harvests averaged 103,200 kg (227,000 lbs)/yr during 1997–2002. Eighty-two percent of this harvest occurred from December through March. Winter harvests peaked during 2002–2003 when 128,900 kg (283,600 lbs) were taken. Good angling success and relatively good ice conditions during that year, compared to other popular ice fishing destinations in southern Minnesota, produced the highest winter angling pressure (1,559,161 angler-hr) ever documented for this fishery. Summer harvest averaged 15,700 kg (34,500 lbs)/yr during 1997–2002.

Sauger populations have increased from very low abundance levels during 1994–1997, when annual fall index netting catches averaged 6.2 sauger/net, to the recent 1998–2002 period when sauger catches averaged 20.1/net. Low sauger abundance during the mid-1990s was likely due to poor recruitment. Although both 1989 and 1990 year-classes were strong, no strong year-classes were produced during 1991–1996, when only three weak year-classes and three of moderate strength were observed. Strong year-classes produced in 1997 and 1999 appear to be driving the recent increase in sauger abundance.

MDNR is presently working with local anglers and businesses to assess walleye/sauger regulation alternatives that will reduce harvest.

Yellow Perch

Yellow perch potential yield for Minnesota waters of Lake of the Woods was estimated at 30,500 kg (67,200 lbs)/yr (Figure 13). Annual harvests during 1997–2002 averaged 25,600 kg

(56,300 lbs)/yr, of which 95% occurred during the winter. If winter angling effort remains high, peak harvests of 32,900 kg (72,400 lbs) in the winter of 2002 may continue at this level.

Annual index netting during 1997–2002 indicated a stable population. Perch catches averaged 20.5 fish/net, with 10 year-classes present. Several strong year-classes were produced in 1994, 1997, 1998, and 1999.

Lake Sturgeon

The potential yield for lake sturgeon in the Minnesota waters of Lake of the Woods and the Rainy River has been estimated at 5,200 kg (11,500 lbs)/yr (Figure 17). Potential yield was based on an estimate of 0.04 kg/ha/yr and the surface area of the system less than 12.2 m (40 ft) deep, which is used by lake sturgeon. Target harvest for the Lake of the Woods/Rainy River population has been set to 66% of the potential yield or 3,500 kg (7,600 lbs)/yr, in order to increase the likelihood and rate of population recovery. This equates to a target harvest of 0.025 kg/ha/yr. Lake sturgeon populations in this area are recovering from overexploitation at the beginning of the last century, and loss of spawning and rearing habitat in the Rainy River from water pollution. There are currently good numbers of juvenile and young adult fish in the population, but very few fish older than age 40.

Although Minnesota's commercial harvest of lake sturgeon was closed in 1930, angling for lake sturgeon has increased dramatically in recent years. Creel surveys indicated that 50% of anglers have only begun fishing for lake sturgeon within the last 5 years. The annual harvest of lake sturgeon averaged 5,100 kg (11,300 lbs)/yr from 1997–2002. MDNR implemented new regulations in 2001 to reduce harvest. Harvest remained above 4,300 kg (9,500 lbs)/yr during 2001 and 2002. Over 6,800 kg (15,000 lbs) were harvested during the two week period from April 15 to April 30 in 2003.

MDNR is implementing additional regulation changes for the spring of 2004. These will include: one sturgeon per licence year; a harvest slot of 114 to 127 cm (45–50 inches) total length; or one fish over 190 cm (75 inches); licence validation when a sturgeon is harvested; a reduced harvest season from April 24 through May 7 and from July 1 through September 30; and catch and release angling seasons from May 8 through May 16 and from October 1 through April 23. The public will also be consulted as to how best to implement a registration system for harvested sturgeon. The new regulations will be evaluated for a period of two years.

Manitoba–Buffalo Bay

Buffalo Bay encompasses an area of 14,700 ha (36,300 acres) on the northwest part of the Big Traverse. Its potential yield has been estimated at 71,300 kg (156,900 lbs)/yr. Angling has increased with the construction of a marina and paved highway at Buffalo Point.

Walleye in Buffalo Bay and the western portion of Minnesota waters are from the same stock. Information is not available on the harvest by Manitoba anglers, but it is believed that the combined harvest by Minnesota and Manitoba anglers is near potential yield.

Rainy Lake Fishery Resource

Lake Description

Rainy Lake is located on the Canada–United States border between northwestern Ontario and north-central Minnesota. The lake covers an area of 92,100 ha (227,500 acres), of which 70,200 ha (173,400 acres) or 76 percent is in Ontario. Three geographically distinct basins form Rainy Lake. Both the North Arm and Redgut Bay lie entirely in Ontario, and the South Arm is divided by the International border. The lake is irregular in shape and has a shoreline of 1,495 km (929 miles) with about 1,600 islands. Rainy Lake has a mean depth of 9.8 m (32 ft) and a maximum depth of 49.1 m (161 ft). Mean summer secchi disk readings vary greatly between basins, ranging from 2.1 m (6.9 ft) on Redgut Bay, 2.7 m (9.0 ft) on the South Arm, to 3.3 m (10.7 ft) on the North Arm.

A hydroelectric dam was constructed at the Rainy River outlet at Fort Frances–International Falls in 1909. Annual water level regulation usually involves a spring build-up, followed by stable water levels during the summer openwater period. The water level during the fall and winter is drawn down for hydro power production. Inflow to Rainy Lake is largely regulated by a hydroelectric dam located at Sturgeon Falls (Crilly) on the Seine River, and by water control dams located at the outlet of Namakan Lake at Kettle and Squirrel Falls. In Ontario, there are three smaller water control structures located at Big Canoe, Footprint, and Manitou rivers.

Water levels are regulated by the International Rainy Lake Board of Control established by the IJC in 1941. The IJC issued a supplemental order in 1970, which provided for year-round operating bands or "rule curves" with lower and upper limits, along with defined levels of emergency conditions. This rule curve was revised in 2000 with a wider operating band during the spring refill period, a modest late summer and fall drawdown period, and the addition of an Emergency Drought Line for dam operations.

No new exotic species were introduced or discovered in Ontario waters since the publication of the 1998 Atlas. However, rainbow smelt have become firmly established since they were first discovered in Rainy Lake in 1990. This species was identified in the North Arm of Rainy Lake in 1991, and the first river spawning run was observed at the Footprint River, Northwest Bay in 1996. Historical records suggest that smallmouth bass and black crappie were introduced into Rainy Lake in the early 1920s. Largemouth bass, pumpkinseed *Lepomis gibbosus*, longear sunfish,

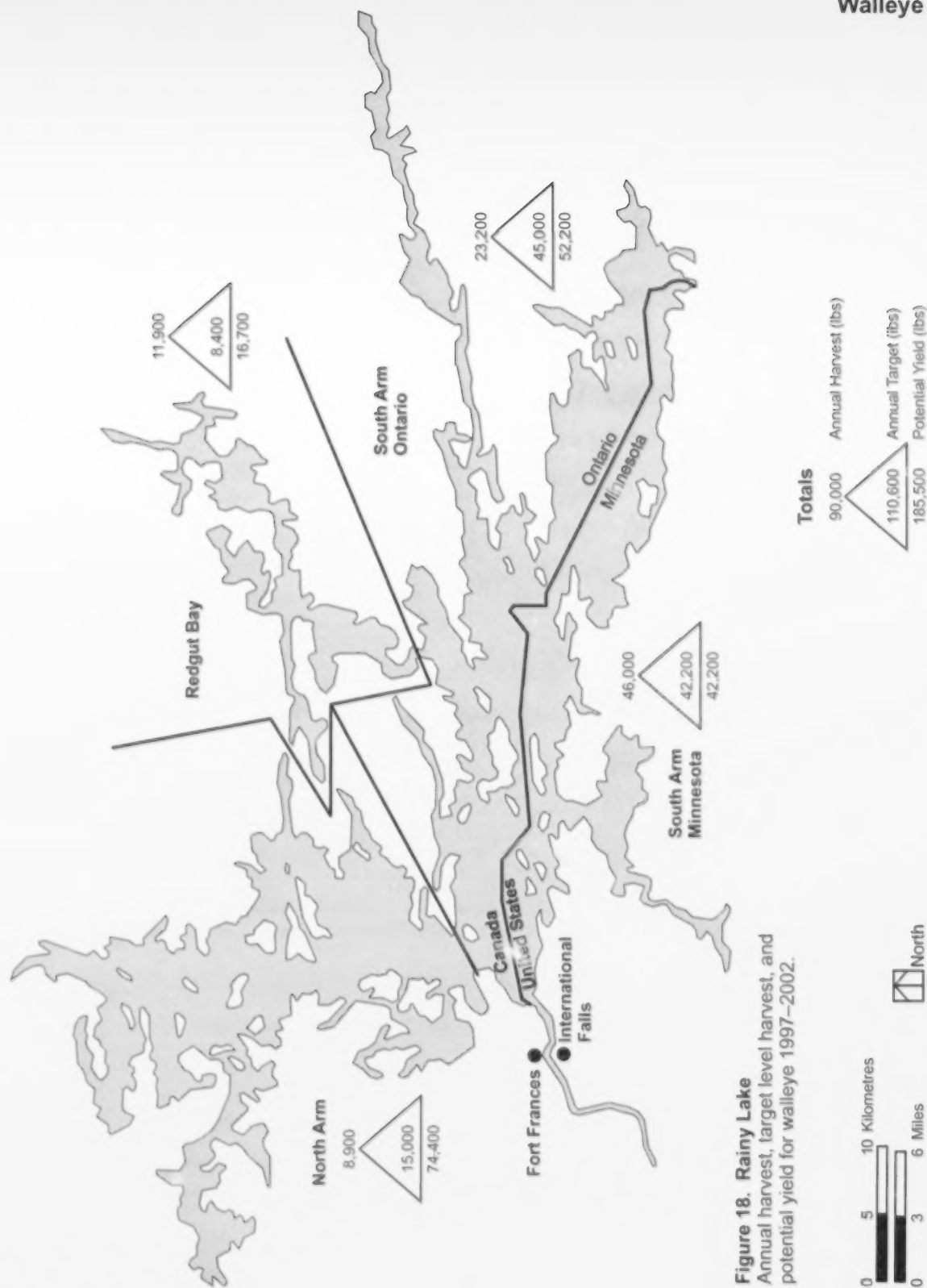


Figure 18. Rainy Lake
Annual harvest, target level harvest, and potential yield for walleye 1997-2002.

Walleye

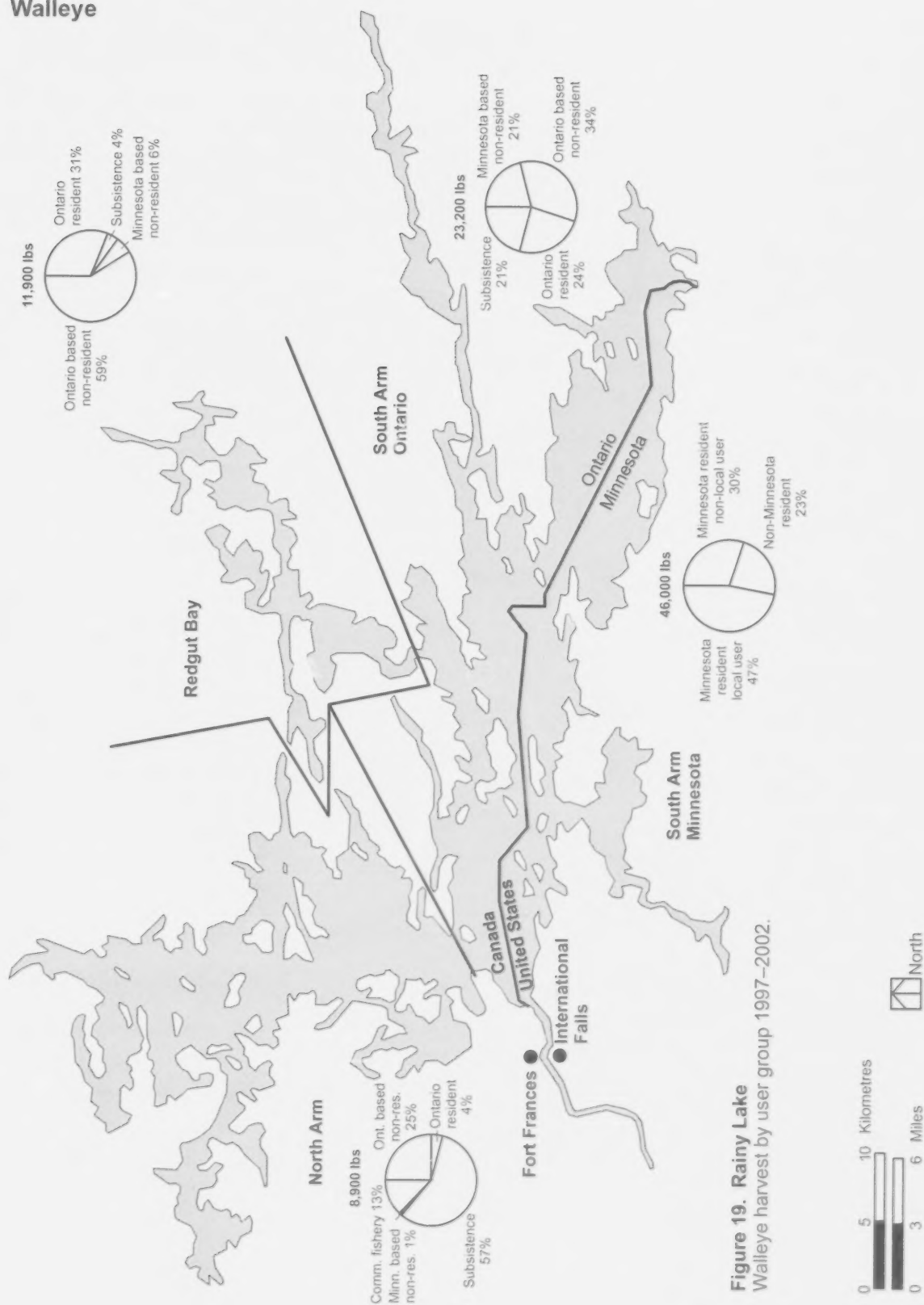
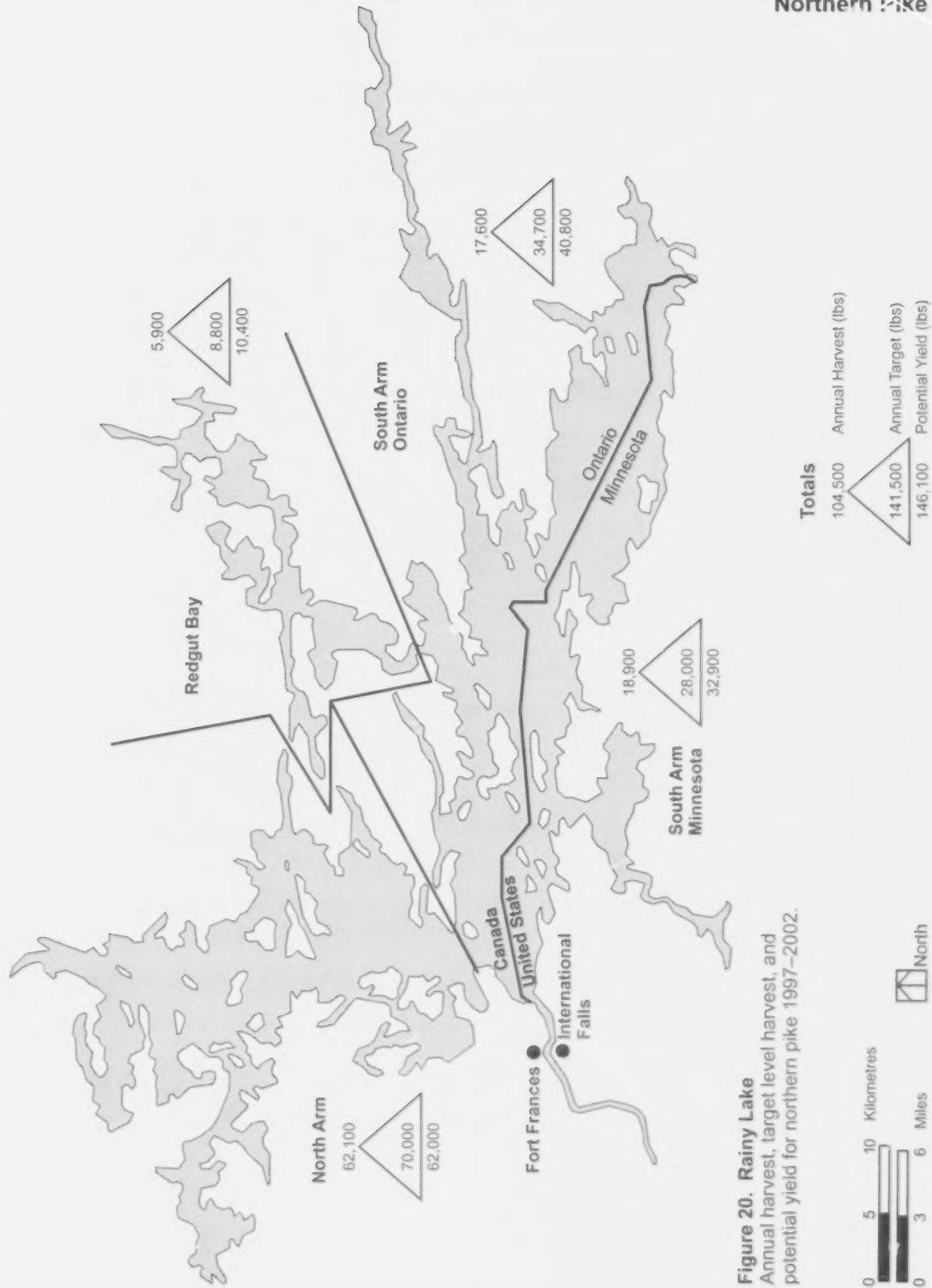


Figure 19. Rainy Lake
Walleye harvest by user group 1997-2002.

Northern Pike



Northern Pike

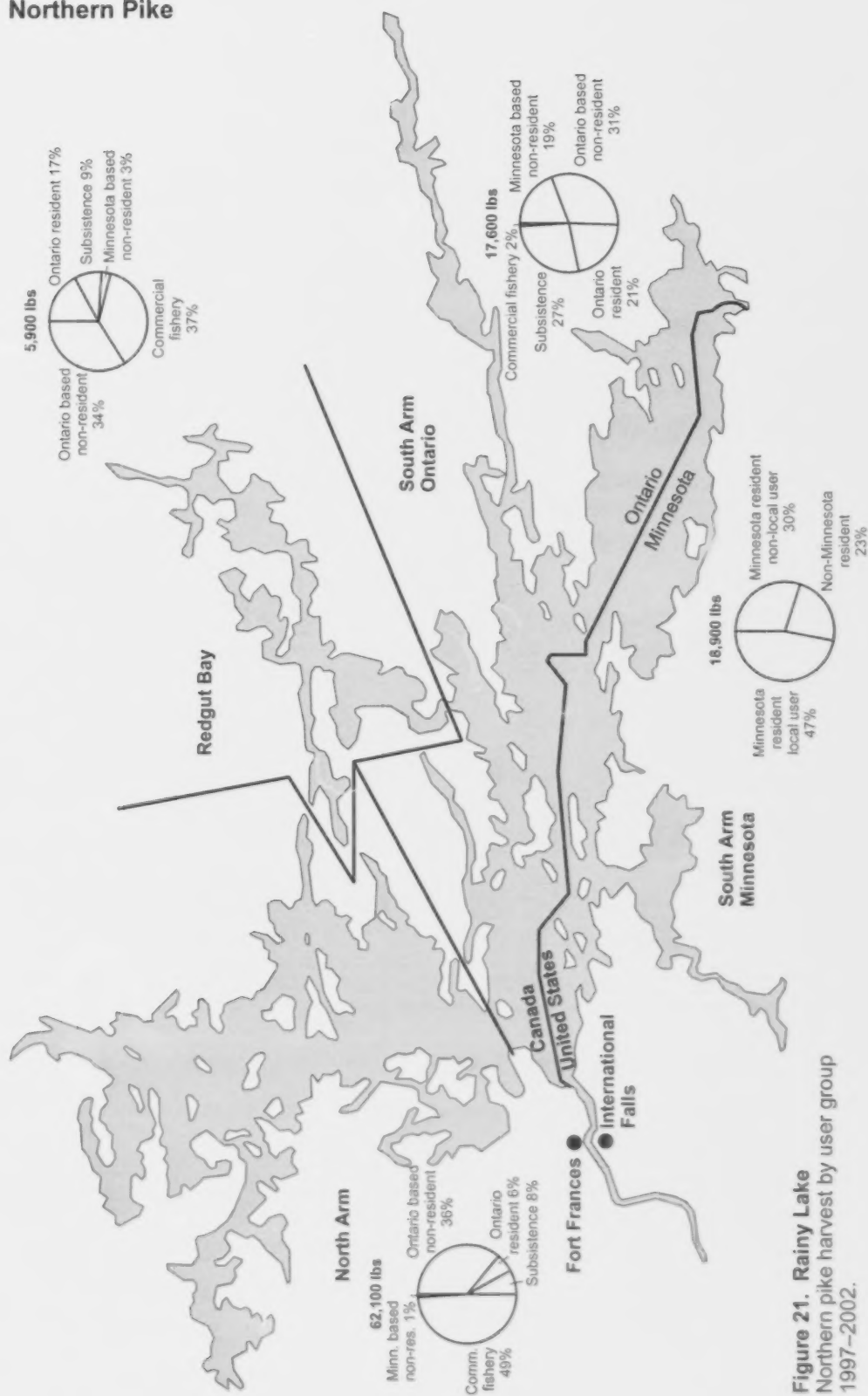
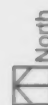


Figure 21. Rainy Lake
Northern pike harvest by user group
1997-2002.



Smallmouth Bass

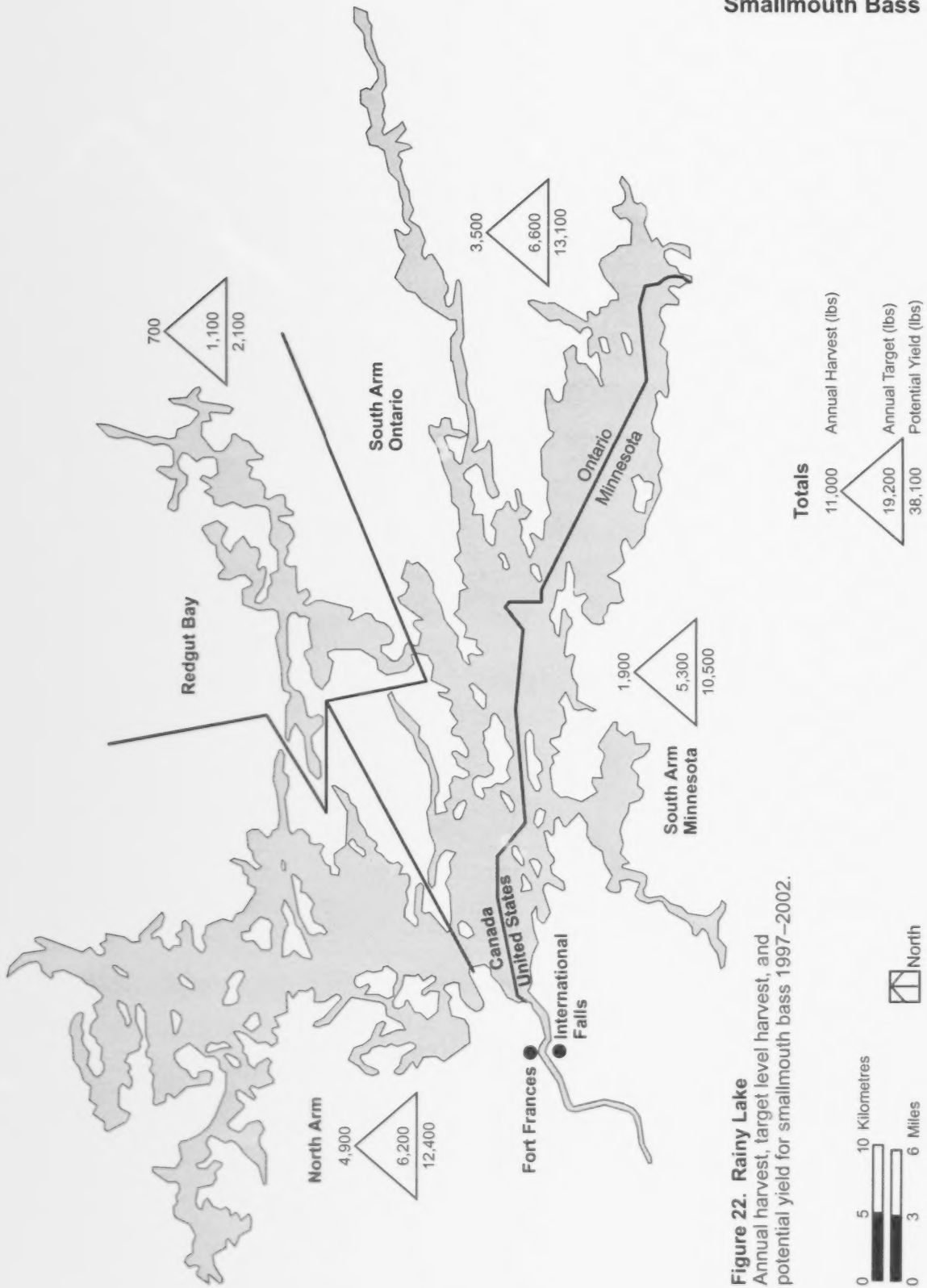


Figure 22. Rainy Lake
Annual harvest, target level harvest, and potential yield for smallmouth bass 1997-2002.

Smallmouth Bass

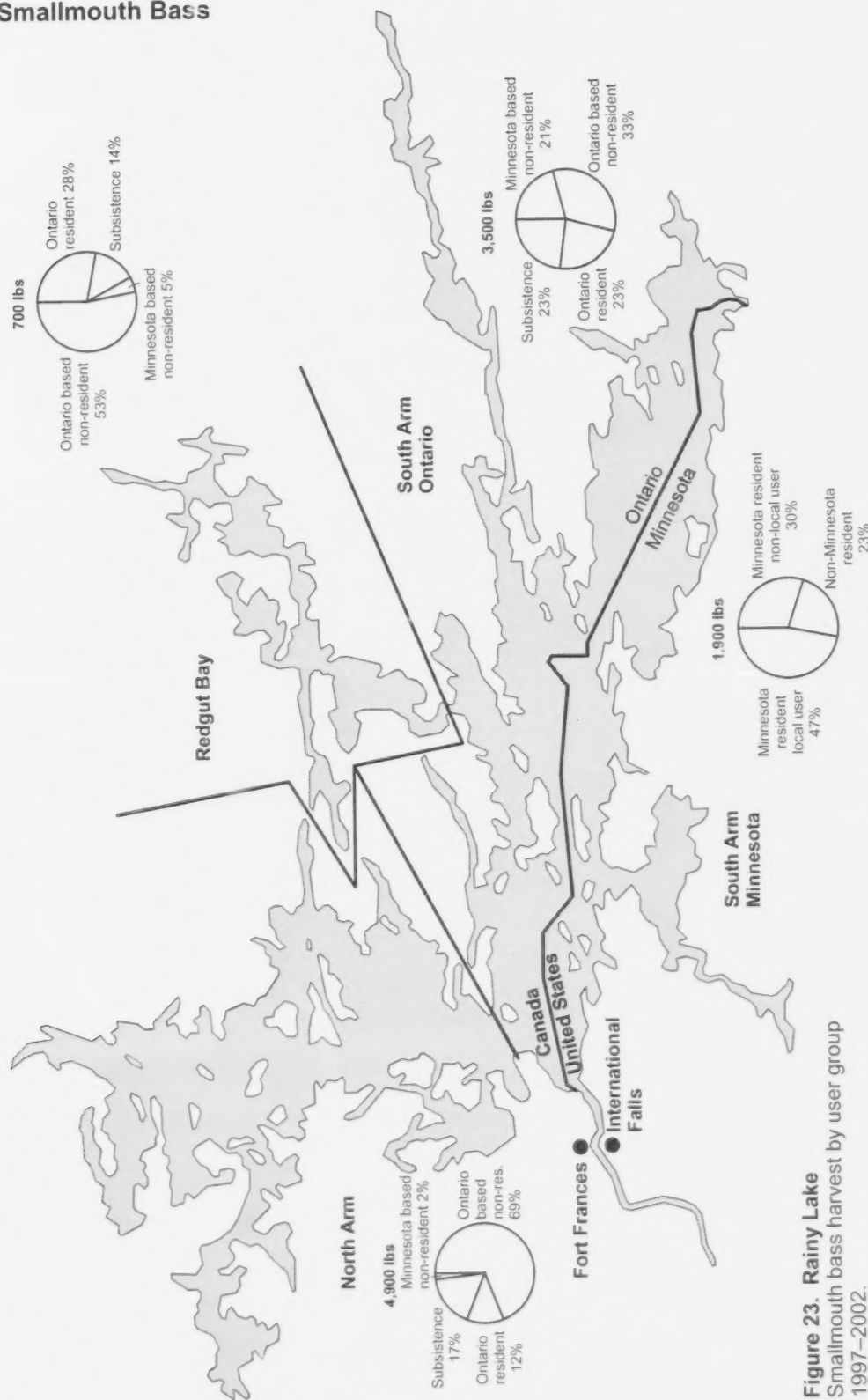
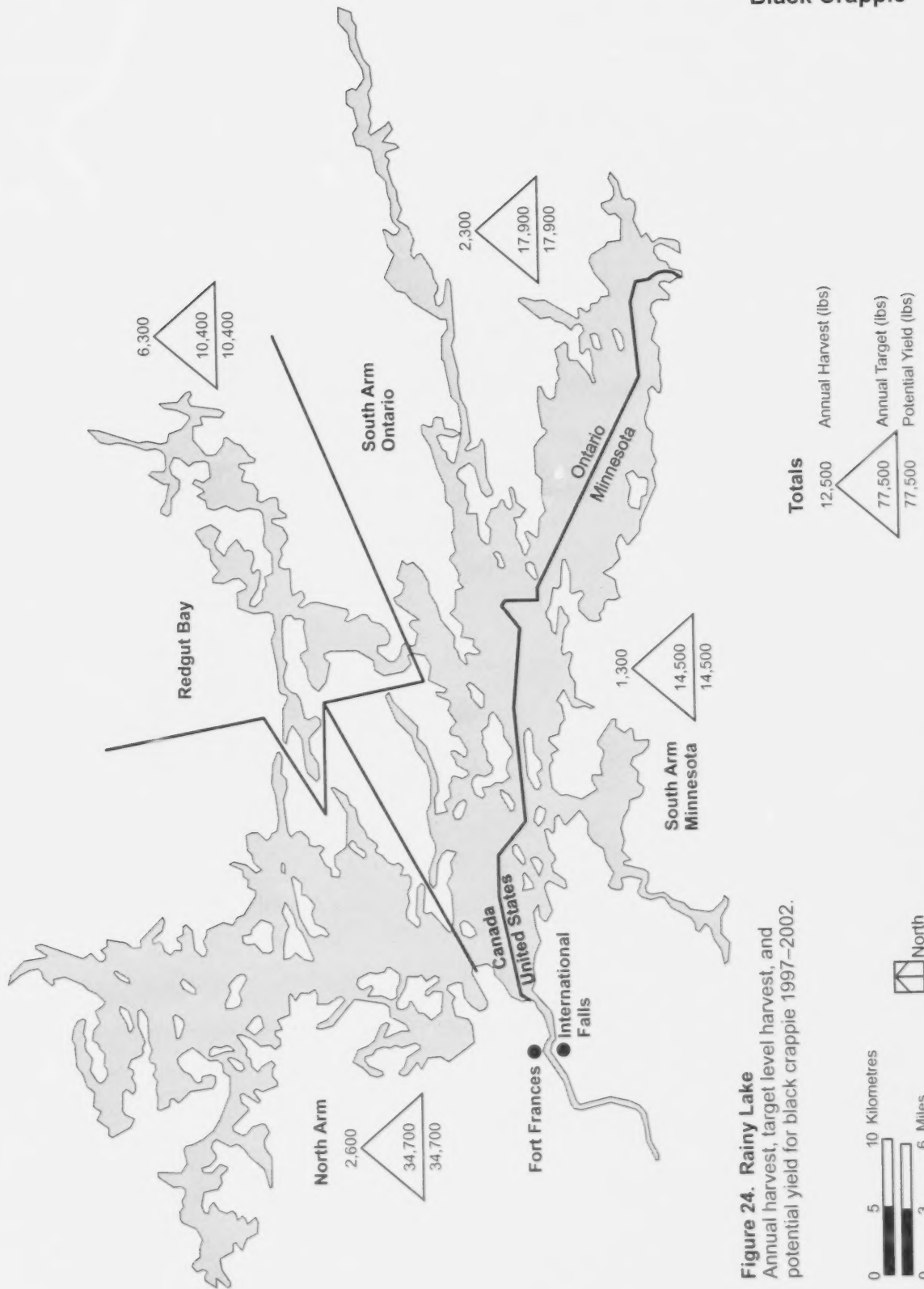
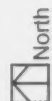
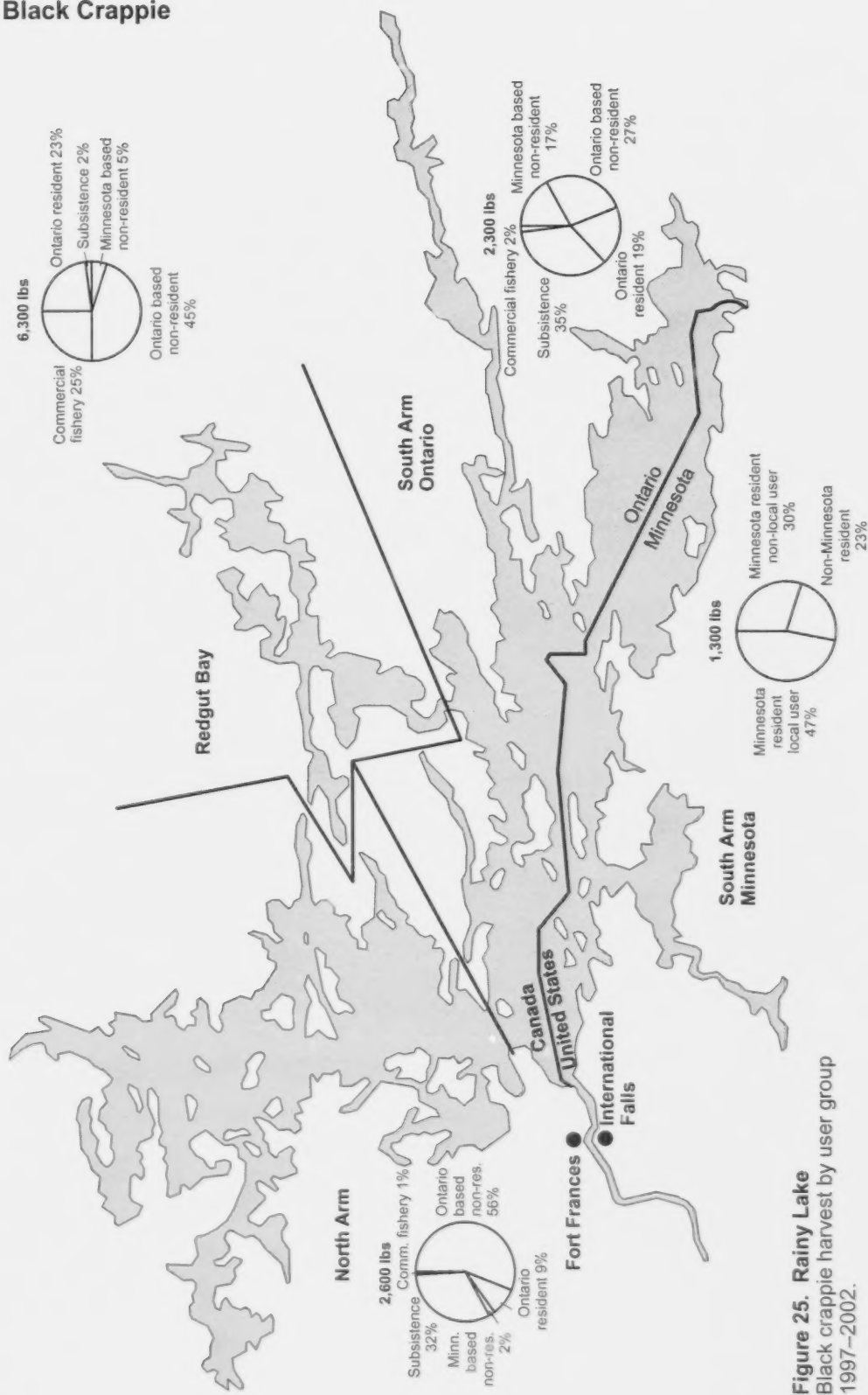


Figure 23. Rainy Lake
Smallmouth bass harvest by user group
1997-2002.

Black Crappie



Black Crappie



Lake Whitefish

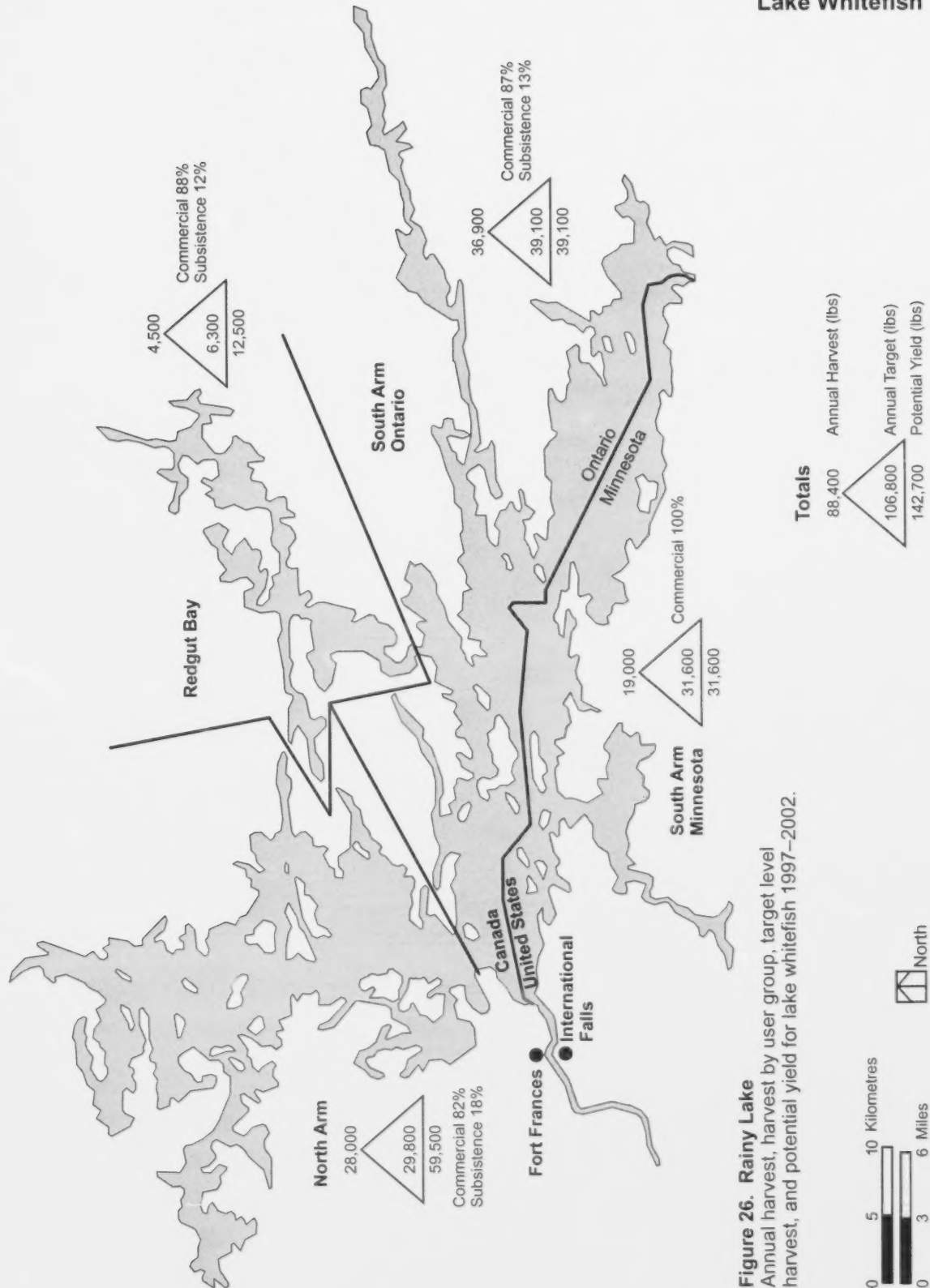
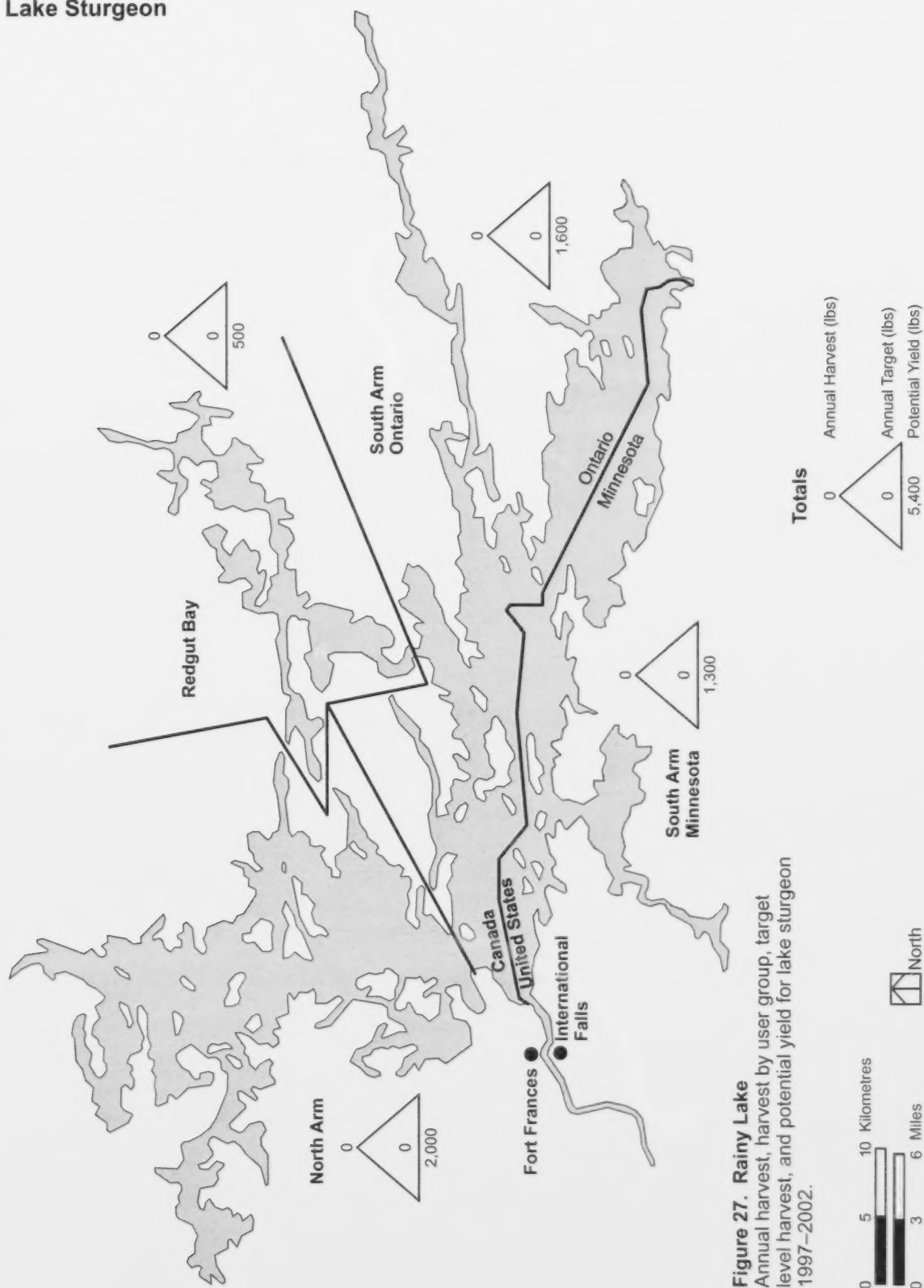


Figure 26. Rainy Lake
 Annual harvest, harvest by user group, target level
 harvest, and potential yield for lake whitefish 1997-2002.

Lake Sturgeon



black and brown bullhead *Ictalurus nebulosus* were first identified in the Rainy Lake system in the 1960s.

Changes to Angling Regulations

Ontario

Changes to angling regulations in 1999, affected most waters in OMNR's Northwest Region including Rainy, Namakan, and Sand Point lakes. New regulations that were previously outlined for Lake of the Woods/Rainy River (see page 12, Changes to Angling Regulations), included: reduced daily catch/possession limits for northern pike, bass, lake trout, black crappie, yellow perch, and lake whitefish; and size limits for northern pike, and bass.

In 2000, the daily catch and possession limit for walleye and sauger (or any combination thereof) was increased in Ontario waters of Rainy Lake from three (3) to four (4). However, as a result of a pending North American Free Trade Agreement (NAFTA) challenge, the walleye catch limit for non-resident of Canada anglers was also changed to one (1) fish per day, and four (4) in possession, of which all must be greater than 35 cm (13.8 inches) and less than 45 cm (17.7 inches), except one (1) greater than 70 cm (27.5 inches). The South Arm Rainy Lake Border Water Conservation Tag (SARLBWCT) program and the associated catch and release only restrictions on U.S. based non-resident anglers were also eliminated.

The minimum length limit for muskellunge in Rainy Lake and the Seine River was increased from 102 cm (40 inches) to 122 cm (48 inches) in 2001.

Minnesota

An experimental regulation was implemented in 1994 that required the immediate release of all walleye from 43–63.5 cm (17 to 25 inches). This was expanded to 43–71 cm (17 to 28 inches) in 2001, along with a reduction in the daily walleye catch and possession limit from six (6) to four (4) walleye per day in 2002. The black crappie catch and possession limit was reduced to 10 fish in 2003.

Current Fish Stock Status

Ontario–North Arm

The North Arm covers an area of 34,600 ha (85,400 acres) with an estimated annual fish yield of 3.26 kg/ha (2.93 lbs/acre) for a total potential harvest of 113,600 kg (250,000 lbs)/yr. Estimated

yields have been revised from previous versions of this Atlas to include lake sturgeon, and to reflect species partitioning of the total MEI potential yield with no residual for forage species. Fish community shifts have also occurred since 1997, with walleye now comprising a major portion of the predator population of the North Arm.

Fish populations in this sector are harvested by commercial fishers, Ontario resident anglers, non-resident of Canada anglers based in both Ontario and Minnesota, and by First Nations for subsistence use. The harvest of fish by Minnesota-based anglers was restricted from 1994 to 1999, and remains low. Angling effort was estimated at 101,500 angler-hr or 2.9 angler-hr/ha (1.2 angler-hr/acre) for this sector in 2002. The North Arm is subject to additional bass angling pressure from competitive fishing events, most notably the Fort Frances Canadian Bass Championship (FFCBC).

Walleye

The potential yield of walleye from the North Arm (Figure 18) is currently estimated at 33,800 kg (74,400 lbs)/yr, or 0.98 kg/ha (0.87 lbs/acre). This has been revised from the previous estimate of 21,400 kg (47,000 lbs)/yr to better reflect potential yield of walleye stocks, as they recover from a depressed state following collapse in the mid-1960s. The revised potential yield more closely approaches historic commercial harvest levels during the pre-collapse period (1948–1961), as well as yields predicted by the recent Thermal Optical Habitat Area model (Lester *et al.* 2002). The recommended 32% partitioning of percids (i.e. walleye, sauger, and yellow perch) from the total yield is consistent with healthy populations in other lake basins, and better represents a angling dominated fishery. The total annual walleye harvest from the North Arm of Rainy Lake averaged 4,100 kg (8,900 lbs)/yr during 1997–2002, down slightly from 4,200 kg (9,200 lbs)/yr during the previous 1990–1996 period. The subsistence harvest, which was estimated at 2,300 kg (5,100 lbs)/yr, represented the largest portion (57%), followed by angling (1,200 kg or 2,600 lbs/yr) and commercial harvest (Figure 19). The commercial walleye harvest which was approximately 6,600 kg (14,500 lbs) in 1986, has been reduced by 94% to 500 kg (1,100 lbs)/yr through government buy-outs and trades for other species quotas.

Reduced harvest and several strong year-classes since 1994 (particularly 1994 to 1998, and 2001) have likely contributed to observed improvements in walleye abundance. Recent reports from anglers, tourist operators, and commercial fishers help confirm that walleye numbers are increasing and population recovery

is underway. The catch of mature walleye in spring trap nets at the Footprint River spawning site increased from 60 fish/year in 1994–95 to a total of 640 walleye captured and tagged in 1997. However, 78% of the catch was comprised of 3-year-old males from the strong 1994 year-class. It was expected that females from this year-class would begin to appear and contribute to the spawning population in 1998. A recent creel survey indicated an improvement in walleye angling success from an observed catch rate of only 0.08 walleye/angler-hr in 1994/95 to 0.25 walleye/angler-hr in 2002. FWIN netting in 1997 and 2002 produced mean catch rates of 16.5 and 28.1 walleye/net, well above mean values for walleye lakes in northwestern Ontario. However, there are still signs of stress, indicating that full recovery of walleye has not yet occurred. Single strong year-class events continued to dominate FWIN catches in 1997 and 2002. Only 13 age classes were represented in the 2002 catch, with a maximum age of 13 years. As a result, the average age of the catch was quite low at only 2.6 years. Walleye growth was also significantly higher than that observed on the South Arm and Redgut Bay. Walleye were also maturing earlier than expected.

A management objective of zero harvest was recommended in the 1992 and 1998 Atlases to allow for rehabilitation of the walleye population in the shortest time possible. As a result of recent indications that brood stock abundance, total abundance and angling success are improving, the recommended management objective for the North Arm has been set at 6,800 kg (15,000 lbs)/yr, well below the potential yield, in order to support continued stock recovery. Full recovery to historical yield levels may still be hampered by changes in the fish community and increased abundance of other species (smallmouth bass, black crappie, northern pike, bullheads, and smelt).

Attempts to rehabilitate walleye in the North Arm have included: a reduction in commercial fishing quotas for walleye through OMNR licence purchases and/or trade for other species quotas; the establishment of sanctuaries from April 1 to June 14 at four known walleye spawning areas in Stanjikoming Bay, Halfway Inlet, Big and Little Canoe rivers; a restrictive size limit for angling; and reductions in the daily catch and possession limit of walleye. OMNR and local sportsmen groups, working together through the Community Fisheries Involvement Program (CFIP), have also rehabilitated two known walleye spawning sites on the North Arm of Rainy Lake (Egg Island, Wasaw Creek) by the addition of over 1,000 cubic yards of rock cobble. Other CFIP projects have improved access for walleye to upstream spawning areas on the Big and Little Canoe rivers, and at Brown's

Inlet by removing obstructions such as beaver dams and log-jams. OMNR was involved in the stocking of 325,500 walleye fry and 34,990 fall fingerlings to supplement natural production in the North Arm during 1985 to 1988. In 1995–1998, the effectiveness of adult walleye transfers, as a rehabilitative technique, was also evaluated, with a sample of 216 tagged adult fish and 21 fish with radio-transmitters.

Northern Pike

The potential yield for northern pike in the North Arm has been estimated at 28,200 kg (62,000 lbs/yr (Figure 20), up from the previous level of 21,400 kg (47,000 lbs)/yr, in place since 1984. This revision better reflects historical commercial harvest levels and the increased production of pike while walleye stocks were depressed. The total northern pike harvest from 1997 to 2002, which averaged 28,200 kg (62,100 lbs)/yr, increased from 24,200 kg (53,200 lbs)/yr for the previous period 1990–1996. Forty-nine percent (13,900 kg or 30,600 lbs/yr) of the harvest was taken by the commercial fishery (Figure 21), followed by Ontario-based non-resident anglers (12,000 kg or 26,400 lbs/yr).

Increased production and improved abundance of northern pike have likely occurred over the long term in the North Arm. Commercial netting catch per unit effort (CUE) for northern pike increased from 1948–1988. OMNR index netting CUEs ranged from 2.4 to 8.4 pike/net since 1965. Recent index netting catches in 1997 were 5.8 fish/net, slightly above the long-term average of 5 fish/net. Although differences in gear selectivity have not been fully evaluated, FWIN catch rates in 1997 and 2002 were lower at 3.7 and 2.5 pike/net. The average age of pike in the 2002 FWIN was four years, with age groups from zero to 13 years present. Catch by weight has increased steadily since 1988, with a historical high of 10.5 kg/net in 1997. Average weights have increased over the past decade with pike foraging heavily on rainbow smelt. Age and size compositions would suggest good abundance of large fish, and availability of trophy angling opportunities. A high-quality angling and commercial fishery for pike currently exists. The northern pike angling success rate was estimated at 0.5 pike/angler-hr in 2002, which was lower than 0.77 pike/angler-hr during the early 1970s. However, this is still well above an angling CUE of 0.1–0.3 pike/angler-hr which is reported to represent a good quantity fishery.

It is recommended that the current management objective of 31,800 kg (70,000 lbs)/yr remain in place, in order to direct harvest pressure to northern pike and to help restore walleye back into the fish community. This level represents

a 30% reduction from the harvest objective of 45,500 kg (100,000 lbs)/yr during 1984 to 1998. A further reduction in the management objective, to a level at or below the potential yield, should be considered in the future, when full recovery of walleye has been achieved. Fish sanctuaries, along with the 1999 size and catch regulations, should also help to improve survival of fish and maintain quality angling opportunities.

Smallmouth Bass/Black Crappie

Smallmouth bass and black crappie are thought to have been introduced into Rainy Lake in the early 1920s, and can now be described as naturalized sport fish species. Largemouth bass and pumpkinseed have been identified in Rainy Lake, but are currently a minor component in the fish community and in the angling harvest. No largemouth bass have been sampled during recent creel surveys, at tournaments or in any other assessment programs. The potential yield estimate for smallmouth bass and black crappie combined has been set at 21,400 kg (47,100 lbs)/yr or 19% partitioning of the total potential fish yield estimate for the North Arm.

The potential yield of **smallmouth bass** has been estimated at 5,600 kg (12,400 lbs)/yr or 5% of the total potential fish yield estimate (Figures 22 and 23). Total estimated harvest averaged 2,200 kg (4,900 lbs)/yr for 1997–2002, slightly above the previous harvest of 1,700 kg (3,700 lbs)/yr during 1990–96. Angling, especially by Ontario-based non-residents, accounted for over 1,900 kg (4,100 lbs)/yr, with the remainder taken by the subsistence fishery. The recent harvest increase is likely due to the popularity and promotion of the quality smallmouth bass fishery, especially since the first Fort Frances Canadian Bass Championship in 1995. The 2002 creel survey indicated that 56% of the openwater angling effort on the North Arm was targeting bass. Angling CUEs peaked at 0.77 bass/angler-hr on the North Arm in 2002 with release rates reaching 96%. The management objective has been set at 2,800 kg (6,200 lbs)/yr or 50% of the annual potential yield to help maintain a quality angling fishery. Bass were historically an underutilized angling species and were promoted as an alternative to walleye and northern pike. Recently however, the importance of maintaining quality smallmouth bass angling opportunities for resident, tourist-based and tournament anglers has been realized. Long-term monitoring and additional regulatory measures (e.g. refinement of seasons, catch limits, and/or size limits) may be necessary to achieve this objective and provide protection to large, trophy fish.

The potential yield of **black crappie** has been

estimated at 15,800 kg (34,700 lbs)/yr or 14% of the total potential fish yield estimate (Figures 24 and 25). Crappies have been assigned the larger portion of the centrarchid yield component, based on long-term yield comparisons with smallmouth bass. Estimated harvest, which averaged 1,200 kg (2,600 lbs)/yr during 1997–2002, has declined since the early 1990s, likely in response to natural fluctuations in abundance and variable year-class strengths. While commercial harvest of black crappie has declined to a negligible amount since 1997, angling and subsistence harvests averaged 800 kg (1,700 lbs)/yr and 400 kg (800 lbs)/yr. Angling CUEs for black crappie have declined to only 0.3 fish/angler-hr, with most of the effort and catch occurring in Northwest Bay. The recommended management objective of 15,800 kg (34,700 lbs)/yr, equivalent to the potential yield, reflects the intent to manage this species for a quantity fishery.

Other Species

The potential yield of **lake whitefish** from the North Arm is estimated at 27,000 kg (59,500 lbs)/yr (Figure 26). Annual harvest averaged 12,800 kg (28,000 lbs)/yr during 1997–2002, up from 8,100 kg (17,700 lbs)/yr for the 1990–1996 period. Commercial harvest accounted for almost 82% of the total, with the remainder taken for subsistence. Population parameters (i.e. age composition, mortality, and age of maturity) from 1997–1998 catch samples have indicated that whitefish populations are improving, but not fully recovered from past overharvest. Whitefish stocks are not as healthy as those sampled in the South Arm. Although the management objective has been increased from 12,500 kg (27,500 lbs)/yr to 13,500 kg (29,800 lbs)/yr, it still represents only 50% of the estimated potential yield for the following reasons: the potential yield estimate for this species based on surface area is likely too high, since whitefish habitat is not uniform throughout the North Arm; recent improvements in commercial catches may indicate that whitefish stocks are recovering from historic low levels of abundance; commercial harvests during the unregulated 1958–1984 period were below this potential yield level, with the exception of 1971–72; and rainbow smelt, which have been present in this basin since 1991, may have long-term impacts on whitefish and cisco populations. The recommended management objective would support existing use while ensuring continued population recovery.

Bullhead populations in the North Arm have expanded since 1989 when they first appeared in OMNR index nets. Bullhead abundance in FWIN catches declined slightly from 36.4 fish/net in 1997 to 27.8 fish/net in 2002. The consequences

of additional fish species in the North Arm fish community will need to be monitored. Dramatic increases in bullhead abundance have been documented in other important Ontario walleye fisheries, such as Lake Nipissing, but populations have declined significantly in nearby Lake of the Woods over the last two decades.

Lake sturgeon were reportedly caught by the commercial fishery in only four years since 1924 when populations collapsed from overfishing. They remain of minor importance in the North Arm fish community. Although First Nations people harvest sturgeon for domestic use, estimates of consumption are not available. Potential yield has been estimated at 900 kg (2,000 lbs)/yr, based on the surface area of the basin less than 9.1 m (30 ft) deep. The management objective has been set at the current harvest level of zero, in order to support recovery (Figure 27).

Sauger, yellow perch, and other species contribute less than 1% to the annual angling catch from the North Arm and are of minor importance in the subsistence fishery. However, a yellow perch commercial fishery has recently developed with annual harvests of 900 kg (2,000 lbs)/yr since 1997. The potential yield and management objective for yellow perch has been set at 2,300 kg (5,000 lbs)/yr, or 2% of the available percid yield. Perch are the principal forage species for walleye, and their current high abundance in FWIN catches (i.e. 20.5 fish/net in 1997 and 37.3 fish/net in 2002) may decline as walleye recovery continues.

Ontario-Redgut Bay

Redgut Bay, which is the smallest of Rainy Lake's three basins, covers 8,300 ha (20,600 acres). The total potential yield has been estimated at 2.85 kg/ha (2.53 lbs/acre)/yr or 23,700 kg (52,100 lbs)/yr. Fish in this area are harvested by Ontario resident anglers, both Ontario and Minnesota-based non-resident anglers, commercial fishers, and by local First Nations communities for subsistence. Angling effort in 2002 was estimated at 73,700 angler-hr or 8.9 angler-hr/ha (3.6 angler-hr/acre), up from 7.1 angler-hr/ha in 1994/95 but slightly lower than 1983–86 levels. Eighty-four percent of effort was for walleye. Effort in excess of 10 angler-hr/ha (4 angler-hr/acre) could compromise walleye angling quality in northwestern Ontario.

Walleye

The walleye potential yield for Redgut Bay is estimated at 7,600 kg (16,700 lbs)/yr or 0.91 kg/ha (0.81 lbs/acre)/yr (Figure 18). Walleye harvests averaged 5,400 kg (11,900 lbs)/yr during 1997–

2002, and 5,500 kg (12,200 lbs)/yr in 1990–1996. While no commercial walleye quotas exist in this area, angling accounted for over 95% of the total harvest, with the remainder taken for subsistence. Angling effort, primarily by Ontario-based non-residents (59%) and Ontario residents (31%) (Figure 19), was higher than other parts of Rainy Lake, due to the higher recreational cottage and tourist industry development on Redgut Bay. The implementation of specific angling regulations in 1994, including changes to walleye catch limits, size limits and non-resident angling restrictions, helped to reduce walleye harvests. However, recent harvest levels have increased with improvements in abundance and an increase in angling effort.

Angling success rates for walleye increased from 0.85 fish/angler-hr in 1994/95 to 1.37 fish/angler-hr in 2001. However, the angling harvest rate continued to decline from a high of 0.60 walleye/angler-hr in 1970 to only 0.16 walleye/angler-hr in 2001. This decline can be attributed to recent size limit and non-resident daily catch restrictions, as well as a higher abundance of younger and smaller fish in the population. Walleye averaged 14.5 fish/net in OMNR index gill nets in 1998, above the long-term average of 10.0 walleye/net during 1965–1988. However, the 1998 FWIN catch of only 7.3 walleye/net suggested that population abundance was still low and dominated primarily by small fish. Age composition was mainly comprised of age four fish from the strong 1994 year-class, with good representation from 1995 and 1996 year-classes. Although fish as old as age 13 were present, mean age of walleyes in the FWIN catch was low at 3.2 years and only five age classes were represented by more than one fish. A very low Fishing Quality Index (FQI; Baccante *et al.* 1991) of 28 indicated that fishing quality was poor when compared to other fisheries.

A management objective of 3,800 kg (8,400 lbs)/yr or 50% of the potential yield is recommended, in order to enhance the angling fishery and to ensure long-term sustainability. This represents an increase from the previous management objective of 2,000 kg (4,400 lbs)/yr established in 1992.

Northern Pike

The potential yield of northern pike is estimated at 4,700 kg (10,400 lbs)/yr (Figure 20 and 21) or 20% of the total potential yield estimate (Appendix 2). Total annual harvest averaged 1,500 kg (5,900 lbs)/yr during 1997–2002, down from 2,800 kg (6,200 lbs)/yr from the previous 1990–1996 period. Commercial fishing and Ontario-based non-resident anglers harvested 1,000 kg (2,200

lbs)/yr and 1,500 kg (3,200 lbs)/yr. Assessment netting has indicated that populations remained relatively stable during 1965–1997. The 1998 mean index net catch of 2.6 pike/net was below the long-term average of 3.7 pike/net. Sample sizes from index netting are generally too small for analysis of population status. Angling success rates, which have steadily increased from 0.33 fish/angler-hr in 1992 to 0.59 fish/angler-hr in 2001, represent good quantity fishing for northern pike. Harvest rates have steadily declined from a high of 0.52 fish/angler-hr in 1970 to only 0.08 fish/angler-hr in 2001. Both the mean age and size of pike harvested by anglers also declined in 2001. This may suggest higher release rates or reduced abundance of fish within a preferred harvest size. Anglers reportedly released an estimated 95% of the northern pike caught in Redgut Bay in 2001. The protected slot and trophy size limit which was introduced in northwestern Ontario in 1999 may also be influencing angler harvest of pike.

Based on available information, the management objective for northern pike from Redgut Bay has been set at 4,000 kg (8,800 lbs)/yr or 85% of the available potential yield for this species, with the intent to maintain or improve fishing quality.

Smallmouth Bass/Black Crappie

Smallmouth bass and black crappie, which were introduced into Rainy Lake in the early 1920s, are now firmly established in Redgut Bay. The potential harvest of both species combined is estimated at 5,700 kg (12,500 lbs)/yr or a 24% partitioning of the total potential yield for centrarchids. Largemouth bass and pumpkinseeds have not been observed in either the fish community or in the angling catch from Redgut Bay.

The potential yield for **smallmouth bass** is estimated at 1,000 kg (2,100 lbs)/yr (Figures 22 and 23). Harvest, primarily by anglers, averaged 300 kg (700 lbs)/yr during 1997–2002, down from 700 kg (1,500 lbs)/yr for the previous 1990–1996 period. Index netting catches have indicated a steady increase in the abundance of bass since they were first captured in assessment gill nets in 1975. A mean catch of 4.8 bass/net in 1998 was well above the long-term average. Angler catch rates have remained relatively stable on Redgut Bay since the early 1990s, with a CUE of 0.37 bass caught/angler-hr. Harvest rates were considerably lower at only 0.03 fish kept per angler-hr, due in large part to catch and release fishing. The size and age of bass harvested by anglers has remained constant since they were first sampled in the 1983 creel survey. Smallmouth bass still provide a quality angling experience, due

to low harvest pressure, even though they were promoted as an alternative species for traditional walleye anglers in the past. A management objective of 500 kg (1,100 lbs)/yr or 50% of the estimated potential yield is recommended, in order to manage for quality angling opportunities.

The potential yield for **black crappie** is estimated at 4,700 kg (10,400 lbs)/yr (Figures 24 and 25). Crappie harvest from 1997–2002 averaged 2,900 kg (6,300 lbs)/yr, down considerably from 9,800 kg (21,500 lbs)/yr in 1990–96. Over 75% of the current harvest or 2,200 kg (4,700 lbs)/yr was taken by the angling fishery. The angling catch peaked in 1992 when over 12,300 kg (27,000 lbs) were harvested. Angling catch and harvest rates in 2001 were highest in Redgut Bay at 0.72 fish caught/angler-hr and 0.47 fish kept/angler-hr. The average age and size of fish in the 2001 catch were the lowest observed in creel surveys since 1983. Current harvests are below the management objective of 4,500 kg (10,400 lbs)/yr. Harvest levels are strongly influenced by stock status, which has shown high natural variability in abundance, regardless of exploitation pressures. The management objective could easily be exceeded during peak harvest years, given the cyclic nature of this fishery.

Other Species

Although the potential yield for **lake whitefish** has been estimated at 5,700 kg (12,500 lbs)/yr based on the surface area of Redgut Bay, the entire bay does not provide uniform whitefish habitat. Since only the south half of this basin has adequate depth to maintain whitefish during warm summer periods, the management objective was reduced by 50% to 2,900 kg (6,300 lbs)/yr to reflect habitat limitations (Figure 26). Whitefish harvests averaged 2,000 kg (4,500 lbs)/yr during 1997–2002, which is higher than 1,000 kg (2,300 lbs)/yr for the previous period from 1990–96. Over 88% of the current harvest is taken by the commercial fishery, with the remainder taken for subsistence. Additional commercial harvest of whitefish would be considered only after a more detailed assessment of stock status is completed, including the impacts of rainbow smelt introductions and the incidental catch of other sport fish in commercial gear.

Bullheads have expanded their range, and were first discovered in Redgut Bay in 1988. Although they have not yet appeared in OMNR index nets, several sightings by anglers and cottagers in the Baseline Bay and Bears Passage areas have been confirmed.

Lake sturgeon were last reported in the commercial and angling harvest from Redgut Bay in 1973. Although First Nations people may

harvest sturgeon for domestic use, estimates of consumption are not available. Potential yield has been estimated at 200 kg (500 lbs)/yr, while the management objective has been set at zero (Figure 27) to allow for continued recovery.

Sauger, yellow perch, mooneye *Hiodon tergisus*, and **rock bass** *Ambloplites rupestris* are of minor importance in the angling and/or commercial fisheries in this area. These species represented only 3% of the total angling harvest in 2001. Sauger numbers have increased in the angling catch, possibly due to changes in the fish community and/or declines in walleye harvest rates. An estimated 100 kg (200 lbs) of sauger were harvested in 2001. Muskellunge are present in this basin and provide limited trophy angling opportunities. Limited information is available to evaluate stock status.

Ontario and Minnesota–South Arm

The South Arm is divided approximately in half by the Canada–U.S. International border. Ontario's portion is roughly 27,300 ha (67,400 acres), or 55% of the total surface area of 49,200 ha (121,500 acres), while Minnesota's portion is 21,900 ha (54,100 acres). The total potential fish yield for all species has been estimated at 2.72 kg/ha (2.42 lbs/acre)/yr or 133,800 kg (294,300 lbs)/yr; 74,200 kg (163,100 lbs) in Ontario and 59,600 kg (131,100 lbs) in Minnesota.

Fish populations are harvested commercially on both sides of the border. Only whitefish can be taken on the Minnesota side, while whitefish, crappie, northern pike, and coarse fish are harvested in Ontario waters. Commercial harvests of sport fish were gradually reduced by gear restrictions and eliminated with a legislated buy-out on the Minnesota side in 1985. Commercial walleye and lake sturgeon harvests in Ontario were eliminated through OMNR purchase of quotas in 1991.

Angling effort in Ontario was estimated at 127,200 angler-hr, or 4.7 hr/ha (1.9 hr/acre) in 2001, with the majority of this effort directed at walleye (71%), smallmouth bass (36%), and northern pike (27%). Effort had increased from 61,700 angler-hr in 1994/95, but remained below the long-term average of 171,800 angler-hr for the period from 1982–92. In 2001, resident and Ontario-based non-resident angling effort reached a historical high, comprising 29% and 43% of the total effort, respectively. Prior to 1994, the majority of recreational angling activity on the Ontario South Arm had been based in Minnesota. From 1994 to 1999, Minnesota-based angling effort in Ontario was significantly reduced through the introduction of non-resident of Canada catch and release

regulations. In 2000, these regulations changed with the elimination of the South Arm Rainy Lake Border Water Conservation Tag and introduction of a daily catch limit of one (1) walleye, and possession limit of four (4), for all non-resident of Canada anglers. Effort and harvest by Minnesota-based anglers in Ontario has increased, as a result of these changes, and overall improvements in fishing quality.

Angling pressure and harvest on the Minnesota side of Rainy Lake have also increased, likely in response to an improvement in the walleye fishery. Angling pressure has more than doubled since 1993. The estimated average angling effort from 1997 to 2002 was 241,465 hr/yr or 11.0 angler-hr/ha (4.5 angler-hr/acres). Seventy-four percent of this angling effort in 2002 was directed towards walleye, similar to previous Rainy Lake creel surveys. The 2002 creel showed that most anglers (63%) on the Minnesota side of Rainy Lake were from more than 48 km (30 miles) away. This continued a recent shift in angler demographics to more non-local angler participation in this fishery.

Walleye

The walleye potential yield of 42,900 kg (94,400 lbs)/yr or 0.87 kg/ha (0.78 lbs/acre)/yr for the South Arm was divided between Ontario and Minnesota, based on surface area (Figure 18). Ontario, with 55% of the South Arm, has a potential walleye yield of 23,700 kg (52,200 lbs)/yr while Minnesota's portion is 19,200 kg (42,200 lbs)/yr.

Ontario

Annual walleye harvest from the Ontario portion of the South Arm which averaged 10,500 kg (23,200 lbs)/yr during 1997–2002 (Figure 18) has declined slightly from harvest estimates of 12,700 kg (27,900 lbs)/yr for the previous 1990–1996 reporting period. This can be attributed to a decrease in angling harvest which was estimated at 8,400 kg (18,400 lbs)/yr or 80% of the total harvest (Figure 19). Prior to the introduction of walleye size and catch limits in 1994, the long-term angling harvest averaged 21,000 kg (46,100 lbs)/yr from 1982–1992. There has been no commercial harvest of walleye since 1990. The subsistence harvest was estimated at 2,200 kg (4,800 lbs)/yr.

Walleye populations in the Ontario South Arm are still considered to be recovering from depressed levels of abundance in the late 1960s, and overharvest during the 1980s and early 1990s. Recent assessments indicated improvements in walleye populations. The mean catch in index gill nets of 12.6 walleye/net in 1999 was equal to the historical high observed

in 1991, and exceeded the long-term average of 7.1 walleye/net. Mean age of the catch was 4.7 years, above the long-term average of 3.9 years. The 1999 age composition was dominated by 5 year olds from a strong 1994 year-class, with good representation of several other year-classes. The abundance of older and larger fish improved for all age classes from 8 to 18 years. The 1999 FWIN catch also averaged 12.6 walleye/net which was slightly below the mean for northwestern Ontario lakes. Fish averaged 3.7 years old in the FWIN, with a maximum age of 13 years. Only nine age groups were represented by more than one fish. The angling success rate for walleye continued to increase, from 0.73 walleye/angler-hr in 1994/95 to 1.00 walleye/angler-hr in 2001. In contrast, the walleye harvest rate has declined from a high of 0.50 walleye kept/angler-hr in 1970 to only 0.15 walleye kept/angler-hr in 2001. Anglers released an estimated 85% of the walleye captured in 2001, largely as a result of the recent size limit and non-resident daily catch restrictions, as well as a higher abundance of younger and smaller fish in the population.

The recommended management objective for Ontario has been set at 20,500 kg (45,000 lbs)/yr, or 85% of the available potential yield, in order to support population recovery and promote high angling quality. Management initiatives to reduce walleye harvest and provide additional protection to the remaining brood stock appear to be working. In 1992, the management objective was reduced by 40% to 11,200 kg (24,600 lbs)/yr, to allow more young fish to survive to maturity, thereby promoting a wider range of age groups in the spawning populations and greater long-term stability. The establishment of fish sanctuaries in 1989 (closed to fishing April 1 to June 14) at Rat River Bay, Stokes Bay Falls, and Pipestone River may have also contributed to the observed improvements in abundance.

Minnesota

Average walleye harvest during 1997–2002 was estimated at 20,900 kg (46,000 lbs)/yr, which was above the target level or management objective of 19,200 kg (42,200 lbs)/yr established by the South Arm Working Group in 2000 (Figures 18 and 19). The annual hooking mortality estimate of 4,100 kg (9,100 lbs)/yr for 2000 to 2002 would bring the total to 25,000 kg (55,100 lbs)/yr. Walleye harvests, which were entirely from the angling fishery, rose sharply from 1996–2000, with a record high harvest of 27,700 kg (60,900 lbs) in 2000. It may be too early to tell whether a subsequent decline in harvest during 2001 and 2002 was the result of new size and catch limit restrictions or other factors.

Recent assessment data have indicated that South Arm walleye populations continue to improve since the 1990s after struggling from decades of overharvest. Analysis of Biological Performance Indicators (Gangl *et al.* 2003) showed no sign of overexploitation. The mean catch of walleye in index (test) gill nets was 5.6 fish/lift in 2002 which was above the historical mean of 4.8 fish/lift. The mean catch of fish greater than 43 cm (17 inches) was 1.2 fish/net, which was above the median for Rainy Lake. The walleye gill net catch included 12 age classes (age 1 to age 12) with a mean age of 4.4 years. At least four strong year-classes were sampled, including 1991, 1994, 1995, and 1997. Historically, Rainy Lake has produced an average of one strong walleye year-class every four years. Early indications have suggested that 2001 was an exceptionally strong year-class. The mean age at first maturity, which has steadily improved, was 6.3 years for females and 5.5 years for males, the highest ever reported for the Minnesota waters of Rainy Lake. Walleye mortality rates have declined. Angler catch rates have improved, especially for walleye greater than 43 cm. It took an average of 30 hours for an angler to catch a walleye greater than 43 cm in 1990, whereas it took only seven hours in 2001.

Several steps have been taken to control walleye harvest and promote recovery of walleye stocks. Commercial fishing ended in Minnesota waters in 1985. A protected slot size along with a reduction in the daily walleye catch and possession limit have been established. In addition, water levels were regulated to improve spring spawning conditions, and the Rainy Lake Sport Fishing Club began promoting catch and release.

Northern Pike

The potential yield for northern pike is estimated at 18,500 kg (40,800 lbs)/yr for the Ontario side and 15,000 kg (32,900 lbs)/yr for the Minnesota portion of the South Arm (Figure 20).

Ontario

Total northern pike harvest for the Ontario portion of the South Arm averaged 8,000 kg (17,600 lbs)/yr during 1997–2002 (Figure 20), and remained unchanged from 8,200 kg (18,100 lbs)/yr reported for the previous 1990–1996 period. Over 70% of the harvest or 5,600 kg (12,400 lbs)/yr was taken by anglers (Figure 21), followed by subsistence (27%), and the commercial fishery (2%). Reductions in the historical northern pike harvest have been achieved by: a decrease in non-resident angling effort; OMNR purchases of commercial fishing quotas; the establishment of fish sanctuaries in prime pike spawning habitat;

and the introduction of a restrictive size regulation. Total annual harvest has been reduced to a level well below the potential yield of 18,500 kg (40,800 lbs)/yr.

OMNR index netting catches have shown a stable trend in northern pike abundance. A mean catch of 3.7 pike/net in 1999 was slightly higher than the long-term average of 2.8 pike/net since 1965. Both the mean size of pike in the catch and the abundance of larger fish have also increased. Fish averaged 4.2 years of age while age groups from 2 to 11 years were represented in the catch. Angling catch rates continued to improve since 1992 with a CUE of 0.87 fish caught/angler-hr in 2001, which was higher than that observed in the North Arm and Redgut Bay.

The recommended management objective of 15,800 kg (34,700 lbs)/yr or 85% of the potential yield will help maintain fishing quality, yet support existing levels of use.

Minnesota

The estimated angling harvest of northern pike from Minnesota waters of the South Arm averaged 8,600 kg (18,900 lbs)/yr from 1997–2002 (Figure 20). Harvests fluctuated greatly during this time period, ranging from 4,000–14,600 kg (8,800–32,200 lbs). Only 3% of anglers who were sampled in the 2002 creel survey were fishing for northern pike. An additional eight percent of all anglers were targeting northern pike, in combination with walleye.

A mean catch of 2.6 northern pike/lift in test gill nets during 2002 was at the historical median for Rainy Lake. Northern pike catches were highest in Black Bay. Fish ranged from 41 to 81.5 cm (16.1–32.1 inches), with a mean length of 53.6 cm (21.1 inches). Five age groups from 2 to 6 years old were sampled, with a mean age of 4.3 years. The total annual mortality rate was estimated at 55%. Two strong year-classes from 1997 and 1998 were evident.

The northern pike target harvest, has been set at 85% of the potential yield or 12,700 kg (28,000 lbs)/yr to maintain and improve quality of the pike fishery.

Smallmouth Bass/Black Crappie

The potential yield of smallmouth bass and black crappie combined for the South Arm has been estimated at 14,100 kg (31,000 lbs)/yr for Ontario and 11,400 kg (25,100 lbs)/yr for the Minnesota portion. This estimate was adjusted from the previous 1998 Atlas to reflect a new partitioning of total fish potential yield at 19% for a centrarchid component. Separate potential yield estimates for smallmouth bass and black crappie were determined by applying the relative

proportion of each species in the total centrarchid harvest. As a result, the potential yield of smallmouth bass (8%) was estimated at 6,000 kg (13,100 lbs)/yr for Ontario waters and 4,800 kg (10,500 lbs)/yr for Minnesota waters (Figure 22). The estimated yield of black crappie (11%) was set at 8,100 kg (17,900 lbs)/yr in Ontario and 6,600 kg (14,500 lbs)/yr in Minnesota (Figure 24).

Ontario

Smallmouth bass harvest averaged 1,600 kg (3,500 lbs)/yr during 1997–2002, down from the previous average of 2,500 kg (5,600 lbs)/yr for 1990–1996. Angling harvest declined from 2,200 kg (4,800 lbs)/yr in 1990–1996 to only 1,200 kg (2,700 lbs)/yr in 2001. Subsistence accounted for the remainder of the harvest (Figure 23). Angling catch rates for bass have improved while harvest rates have declined, owing largely to increased catch and release fishing. Rates averaged 0.6 bass caught/angler-hr and 0.03 fish kept/angler-hr in 2001. It was estimated that 97% of the bass caught by anglers in the South Arm during 2001 were released. Both size and age of bass harvested by anglers have remained consistent since 1983. Index netting peaked at 1.3 bass/net in 1999, slightly above the long-term average of 0.8 bass/net. Smallmouth bass still provide a quality angling experience, due to low harvest pressure. This can be maintained by limiting harvest to within the revised management objective of 3,000 kg (6,600 lbs)/yr or 50% of the potential yield (Figure 22). Additional measures such as reduced catch limits and/or size-based regulations may be necessary in the future to maintain a quality fishing objective.

Black crappie distribution and habitat is limited in this basin. This species is most abundant in the Rice Bay, Grassy Portage Bay, Little Grassy Lake, and Stokes Bay areas. Total annual harvest of crappie averaged 1,000 kg (2,300 lbs)/yr during 1997–2002, well below the potential yield (Figure 24) and also well below the previous average harvest of 3,000 kg (6,600 lbs)/yr for 1990–96. Angling catches of 700 kg (1,500 lbs)/yr represented the majority of this harvest, followed by subsistence and commercial fishing. A management objective of 8,100 kg (17,900 lbs)/yr or 100% of the potential yield is recommended.

Minnesota

The average annual harvest of **smallmouth bass** was 900 kg (1,900 lbs)/yr from 1997–2002 (Figure 22), which was equal to the long-term harvest mean for this species. Only 2% of all anglers interviewed in 2002 were targeting smallmouth bass, while 3% were fishing for smallmouth bass in combination with other

species. Anglers reportedly released 87% of the bass that they caught. Interest in tournament fishing for smallmouth bass on the Minnesota side of Rainy Lake has grown.

Bass abundance averaged 29 fish/hr during electrofishing surveys in August 2002, which is near the 10-year average. Several strong year-classes were present, including 2002. Age and growth analysis of catch samples from the Denny's Super 30 Bass Tournament in 2000 indicated that smallmouth growth on Rainy Lake is among the fastest in the International Falls Fisheries Management area. The smallmouth bass target harvest has been set at 50% of the potential yield or 2,400 kg (5,300 lbs)/yr, in order to maintain and improve the quality of this fishery.

Black crappie harvest averaged 600 kg (1,300 lbs)/yr from 1997–2002, well below the target of 6,600 kg (14,500 lbs)/yr which was set at 100% of the potential yield (Figure 24). Yields fluctuated during this time period from 60 to 2,000 kg, likely in response to variable recruitment. Spring trap netting in 2002 provided the best net catches of black crappie during the past decade. Three strong year-classes from 1995, 1997, and 1998 were sampled and should contribute to higher yields in the coming years.

Other Species

The potential yield for whitefish in the South Arm is estimated at 17,800 kg (39,100 lbs)/yr for the Ontario side and 14,400 kg (31,600 lbs)/yr for the Minnesota portion, which totals 32,200 kg (70,700 lbs)/yr for the entire basin (Figure 26). Lake sturgeon have an estimated potential yield of 700 kg (1,600 lbs)/yr for Ontario and 600 kg (1,300 lbs)/yr for Minnesota, with a total South Arm yield of 1,300 kg (2,900 lbs)/yr (Figure 27). This was based on a sustainable yield estimate of 0.04 kg/ha (0.04 lbs/acre)/yr for the lake surface area less than 12.2 m (40 ft) deep.

Ontario

The average annual harvest of **lake whitefish** was estimated at 16,800 kg (36,900 lbs)/yr during 1997–2002, of which 87% or 14,600 kg (32,100 lbs)/yr was caught by the commercial fishery while the remainder was taken for subsistence (Figure 26). This level of harvest was below the potential yield, but higher than the previously reported average of 11,600 kg (25,500 lbs)/yr for 1990–1996. Long-term monitoring of the commercial catch has shown that growth, maturity, age and size distributions are indicative of healthy populations, and that harvests are sustainable at current levels. Bi-annual catch sampling from 1987 to 1997 also indicated that whitefish populations have improved significantly over historical levels.

The average age of the catch was 10.4 years in 1999, and fish from 5 to 22 years old were represented in recent catches. Smelt abundance has declined in recent years, and does not appear to have affected whitefish recruitment in the South Arm. As a result, it is recommended that the management objective be revised upward to the potential yield level of 17,800 kg (39,100 lbs)/yr.

Sauger, yellow perch, mooneye, and rock bass are of minor importance in the angling and commercial harvest from this basin. Sauger have declined in the angling catch since the early 1980s, owing to a number of factors including their small average size, changes in angler preferences, and/or shifts in fish community structure. The index net catch has declined steadily since 1988, to a low of 2 fish/net in 1999, which is below the long-term average of 4.3 sauger/net. Less than 50 kg (100 lbs) of sauger were harvested by anglers in 2001.

Brown bullhead abundance in index gill nets has declined in recent years, from a peak of 18.2 fish/net in 1991 to a low of 0.1 fish/net in 1999. **Muskellunge** are also present in this basin, especially in the Seine Bay and Lower Seine River area, and are providing limited trophy angling opportunities. Angler reports suggest that some trophy-sized fish, approaching 140 cm (55 inches) in length, have been captured in recent years.

Lake sturgeon were caught historically by the commercial fishery which was regulated by quota until the last remaining licence was purchased by OMNR in 1991. Although First Nations people harvest sturgeon for domestic use, current estimates of consumption are not available. The potential yield was estimated at 700 kg (1,600 lbs)/yr. A management objective of zero harvest (Figure 27) is recommended, in order to allow for continued stock recovery. Cooperative assessment work (tagging, radio-telemetry, index netting) on lake sturgeon in the South Arm was begun in 2002, and will continue through 2005.

Minnesota

The annual commercial harvest of **lake whitefish** (Figure 26) averaged 8,600 kg or 19,000 lbs/yr (16,100 lbs dressed weight) during 1997–2002, well below the target of 14,400 kg (31,600 lbs or 26,860 lbs dressed). The target has been set at 100% of the potential yield. The commercial fishery is managed with a quota, gear restrictions, and season closures.

Sauger and yellow perch were minor components of the fishery during 1997–2002, with an average yield of 600 kg (1,400 lbs)/yr and 50 kg (110 lbs)/yr, respectively. This was consistent with the long-term average harvest estimate for these two species. Although **lake sturgeon** are

occasionally caught and harvested by anglers, sturgeon have never been documented in the annual creel survey; therefore, the lake sturgeon harvest was estimated to be zero (Figure 27). The lake sturgeon target harvest has been set at zero, in order to promote stock recovery.

Namakan Lake Fishery Resource

Lake Description

Namakan Lake is located on the Ontario–Minnesota border and encompasses a total area of 10,100 ha (25,000 acres), with 51% or 5,150 ha (12,750 acres) in Ontario and 49% or 4,950 ha (12,250 acres) in Minnesota. Namakan Lake is typical of lakes within the Canadian Shield and the southern range of the boreal forest in North America. The waters are soft and mesotrophic, or intermediate in lake productivity. Aquatic vegetation is sparse. Only 20% of the lake consists of littoral area, although its shoreline stretches for over 235 km (146 miles) and its island shoreline for another 169 km (105 miles). The mean depth is 13.6 m (45 ft), with a maximum recorded depth of 45.7 m (150 ft). Namakan Lake has a water transparency of 2.6 m (8.5 ft), as measured by a mean summer secchi disk reading.

Namakan Lake is part of the Namakan Reservoir which also includes Kabetogama, Crane, Sand Point, and Little Vermilion lakes.

Namakan Reservoir has a drainage basin area of 19,300 km² (7,452 miles²) and is part of the headwaters of the Winnipeg–Nelson River system. Two regulatory dams in operation since 1914 are located at Kettle and Squirrel falls at the outlet of Namakan Lake. Water levels were originally controlled by natural rock sills at this location, which supported the integrity of the lakes at slightly lower levels. The water level in Namakan Lake is regulated by the International Joint Commission through the International Rainy Lake Board of Control (IRLBC). Regulation of lake levels is based upon a "rule curve" that was established by the supplemental order of 1970, and revised in 2000. The rule curve requires that water levels be maintained within a defined band of lake elevations during normal operations at any particular time of the year. Until year 2000, Namakan Lake had an annual fluctuation of 2.7 m (8.9 ft) versus 1.8 m (5.9 ft) during the pre-dam era. It also had higher summer and fall water levels and a significantly greater overwinter drawdown. Peak water levels that would normally occur during late May or early June were delayed approximately one month to peak in late June, or early July. This water level management system was found to adversely affect the aquatic ecosystem, and was therefore revised by the IRLBC and the IJC in January 2000. Revisions to the rule curve included a reduction in the overwinter drawdown by approximately 1.1 m (3.4 ft), a gradual summer drawdown to begin in June, and the addition of an Emergency Drought Line for dam operations.

Walleye

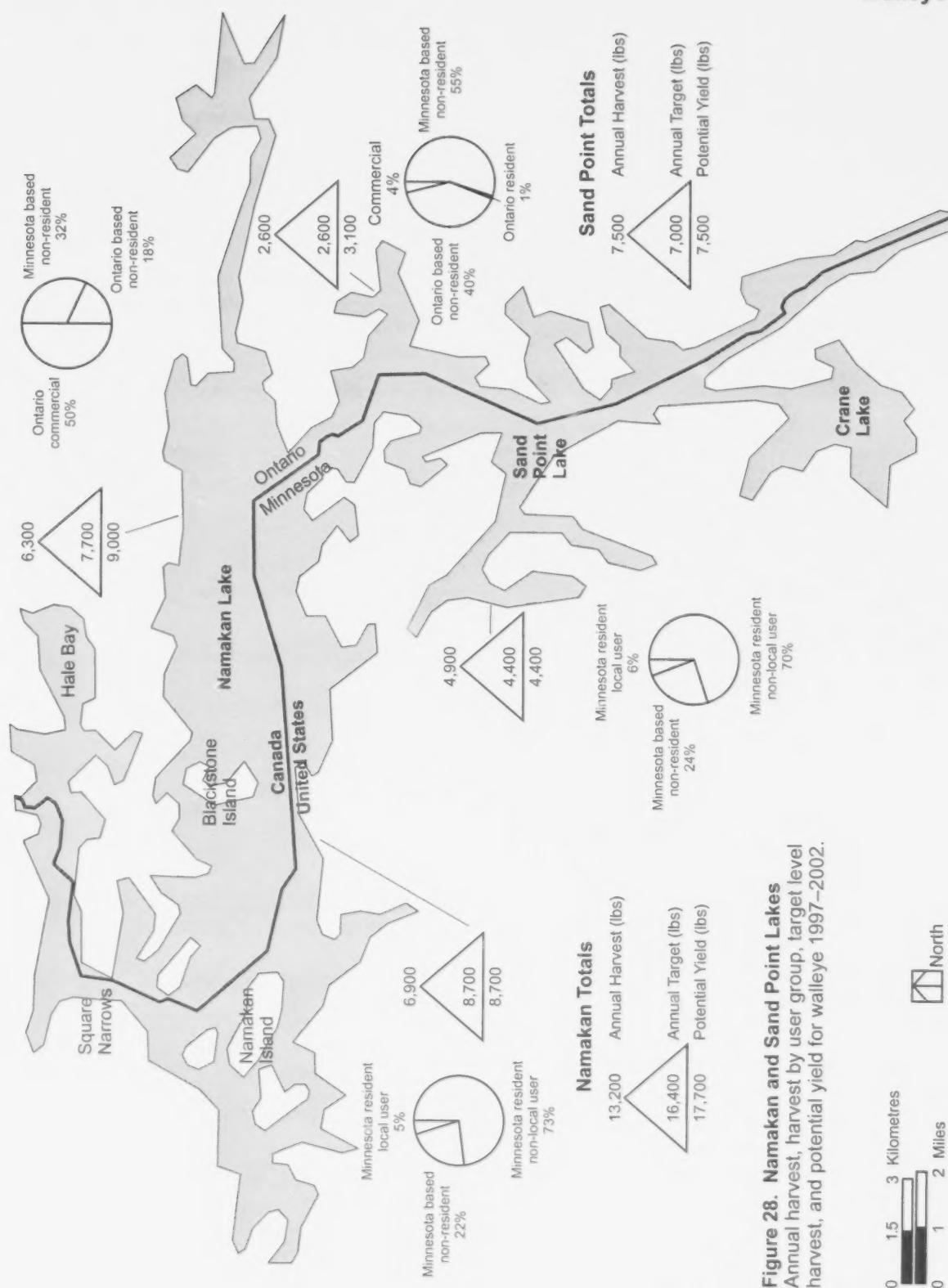


Figure 28. Namakan and Sand Point Lakes
Annual harvest, harvest by user group, target level harvest, and potential yield for walleye 1997-2002.

Northern Pike

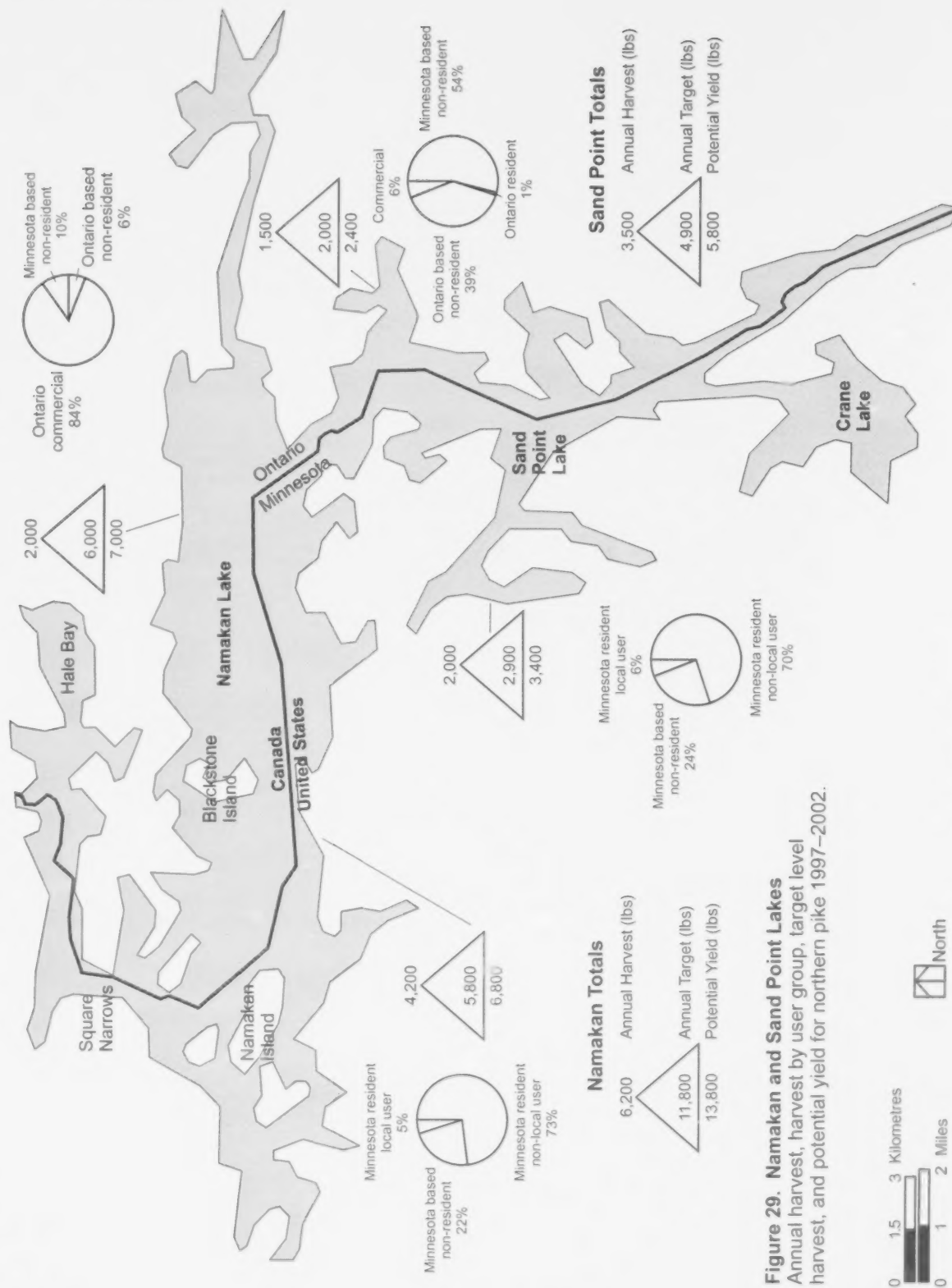


Figure 29. Namakan and Sand Point Lakes
Annual harvest, harvest by user group, target level
harvest, and potential yield for northern pike 1997-2002.

Smallmouth Bass

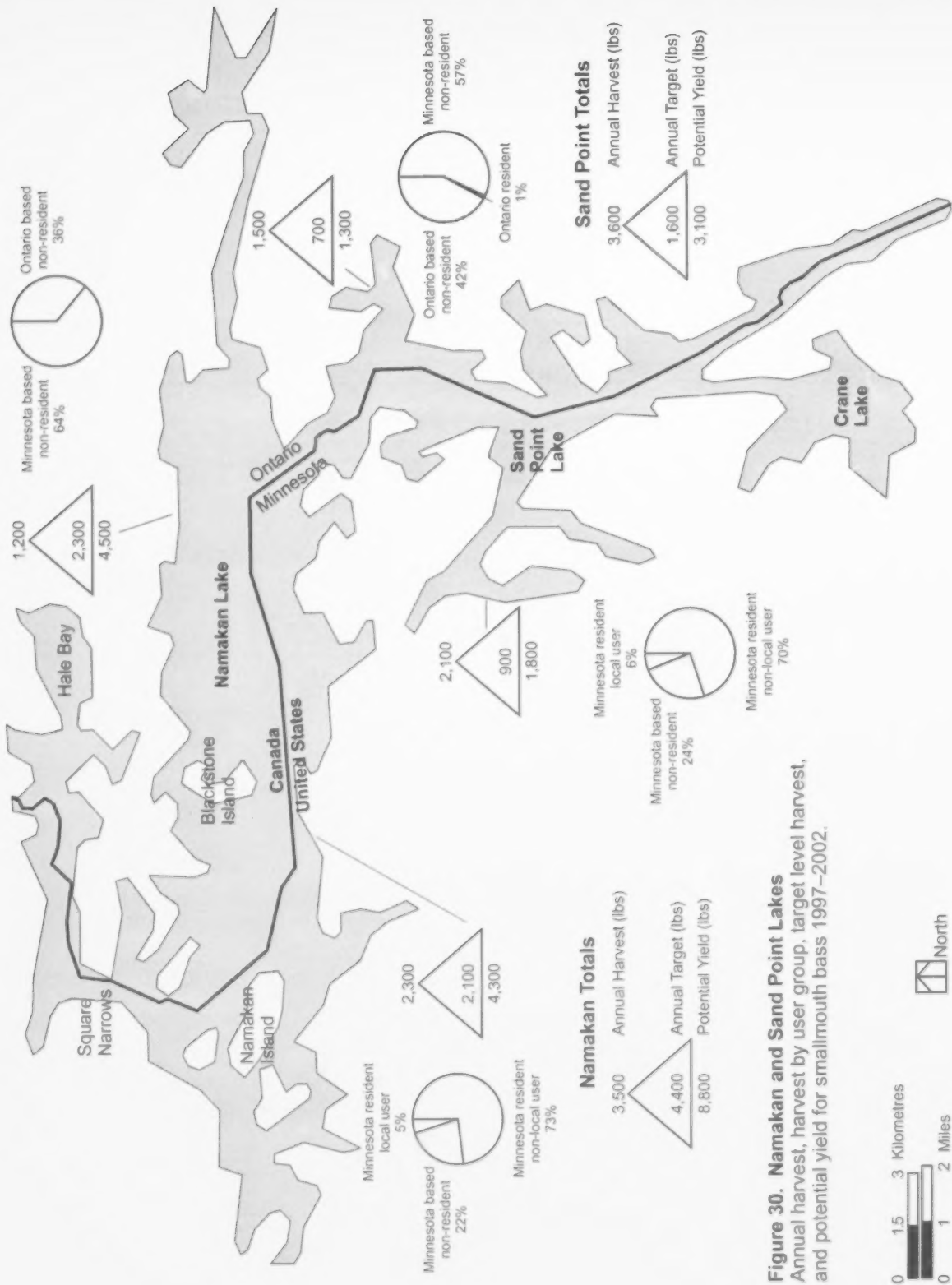


Figure 30. Namakan and Sand Point Lakes
Annual harvest, harvest by user group, target level harvest, and potential yield for smallmouth bass 1997-2002.

Black Crappie

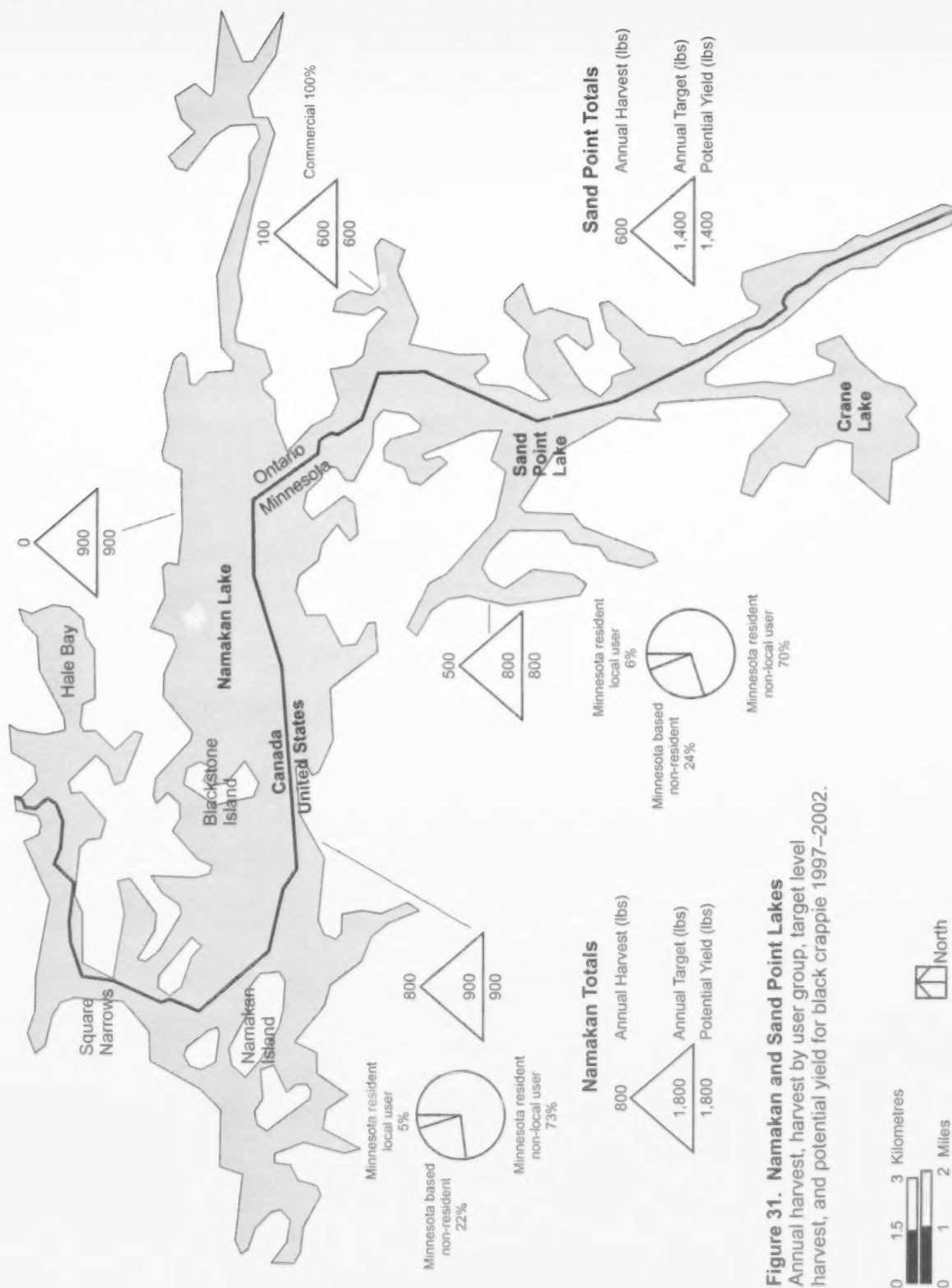


Figure 31. Namakan and Sand Point Lakes
Annual harvest, harvest by user group, target level
harvest, and potential yield for black crappie 1997-2002.

Lake Whitefish

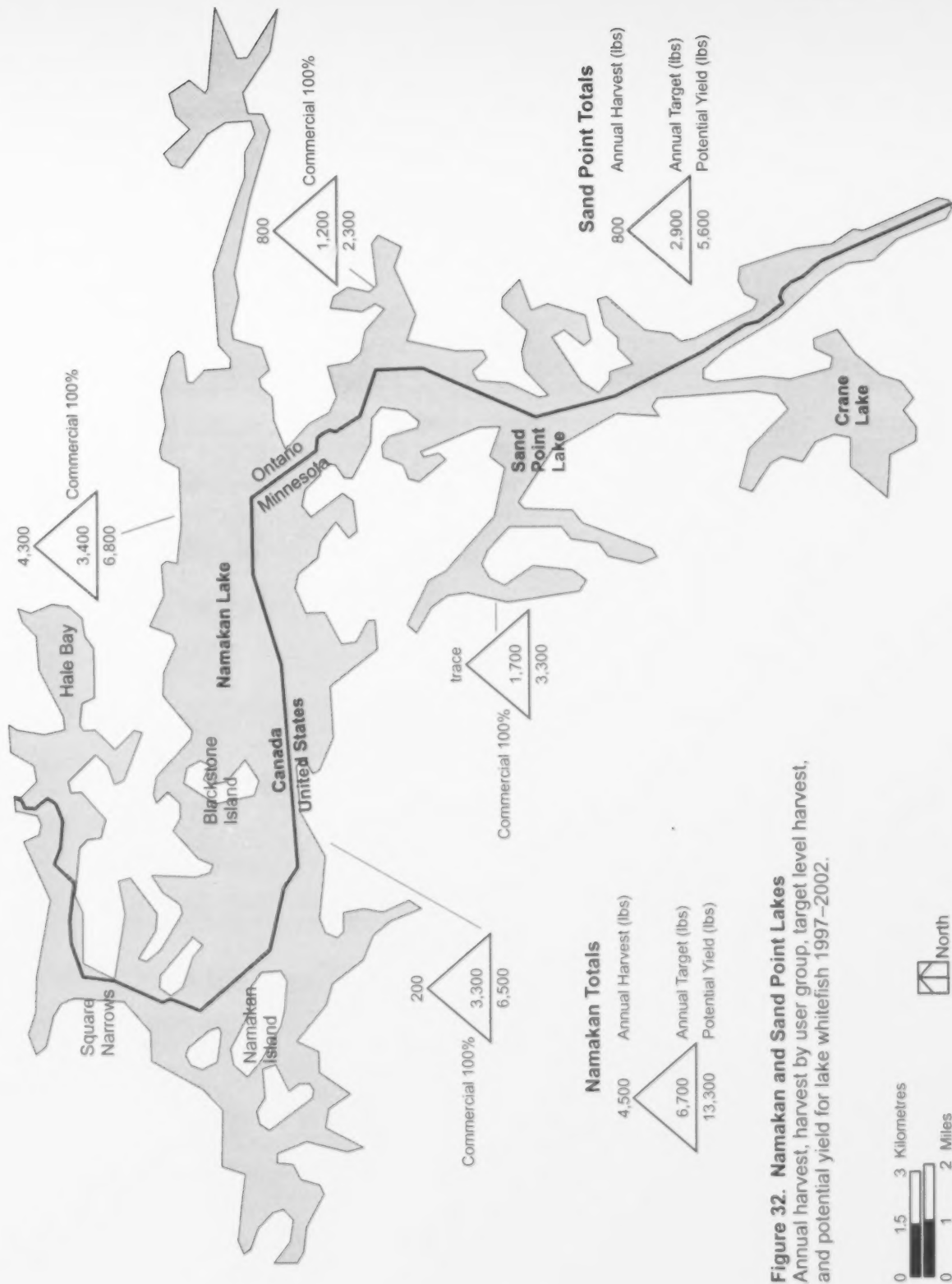


Figure 32. Namakan and Sand Point Lakes
Annual harvest, harvest by user group, target level harvest, and potential yield for lake whitefish 1997-2002.

Lake Sturgeon

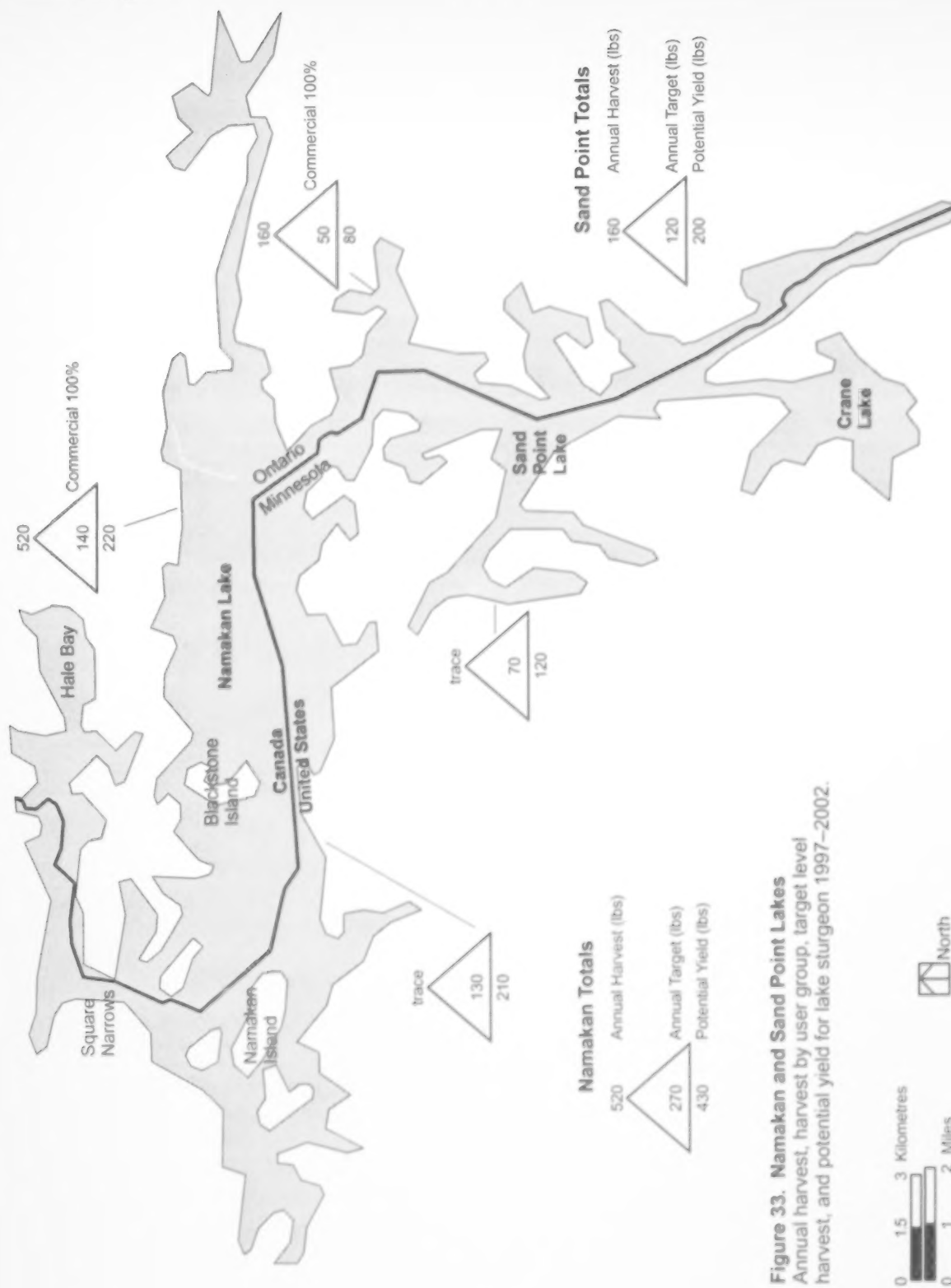


Figure 33. Namakan and Sand Point Lakes
Annual harvest, harvest by user group, target level
harvest, and potential yield for lake sturgeon 1997-2002.

Namakan Lake is accessible by the Flanders Road to the Namakan River in Ontario. Access is also obtained via waterways from Kabetogama and Sand Point lakes, or by marine portage from Rainy Lake at Kettle Falls, Minnesota. The Minnesota side of the lake lies within Voyageurs National Park. Development on the lake consists of one tourist establishment, one recreational camp site and numerous cottages on 37 patent properties in Ontario, and a few scattered cabins and national park campsites on the Minnesota portion. Commercial fishing on Namakan Lake began in 1916–17. With the growth of the tourism industry, commercial fishing for walleye and northern pike was eliminated in Minnesota waters in 1946, although one licensed commercial fishery for lake whitefish remains today. A commercial fishery for walleye, northern pike, lake whitefish and sturgeon existed on the Ontario side until it was eliminated through government purchase in 2002.

No new exotic species have been introduced or discovered in Ontario waters since 1997. However, rainbow smelt have become firmly established since they were first discovered in 1990.

Changes to Angling Regulations

Ontario

Several angling regulation changes, including size and catch limits for most species, were implemented in 1999. The daily catch and possession limit for walleye was reduced from six (6) to four (4), and the maximum size limit of one (1) fish greater than 50 cm (19.5 inches) was reduced to one (1) fish over 46 cm (18 inches). A protected slot and trophy size limit for northern pike was established whereby no pike may be kept from 70 to 90 cm (27.5 to 34.5 inches) total length, with only one (1) fish over 90 cm. The daily catch and possession limit was reduced from six (6) to four (4) fish. A maximum size limit was also introduced for smallmouth and largemouth bass (in combination) that allows only two (2) bass to be kept under 35 cm (13.8 inches) from December 1 to June 30 each year, with a daily catch and possession of four (4) fish during the remainder of the year. The daily catch and possession limit of black crappie for regular licence holders was also reduced from 30 to 15 fish. As a result of a pending NAFTA challenge, the catch limit of walleye and/or sauger for non-resident of Canada anglers was changed in 2000 to two (2) fish daily, and four (4) in possession for regular licence holders. The minimum size limit for muskellunge was also increased in 2000 from 102 cm (40 inches) to 122 cm (48 inches).

Minnesota

A new walleye size regulation was implemented on Minnesota's portion of Namakan Reservoir in 1998. The new regulation allows anglers to harvest walleye greater than 33 cm (13 inches) or less than 43 cm (17 inches). In addition, only one walleye greater than 58 cm (23 inches) can be kept in a daily catch and possession limit of six (6). This experimental regulation will expire March 2007. The black crappie daily catch and possession limit of 30 was reduced to 10 in May 2003.

Current Fish Stock Status

As with the other border waters, potential yields, annual harvests, and past management objectives were compared to assess the status of walleye, northern pike, smallmouth/largemouth bass, yellow perch, and black crappie in Namakan Lake (Figures 28 to 33). Potential yields for each species were determined by partitioning the total potential yield derived from the morphoedaphic index (MEI), which has been updated using new information on water chemistry and lake depth.

The potential annual yield for all species of fish was estimated at 2.49 kg/ha (2.22 lbs/acre), or 25,100 kg (55,300 lbs)/yr. The annual harvest for all species (excluding perch and sauger) from 1997 to 2002 was 1.30 kg/ha (1.15 lbs/acre) or 13,100 kg (28,800 lbs)/yr.

Angling effort in Ontario in 1998 was estimated at 18,800 angler-hr, or 3.6 angler-hr/ha (1.5 angler-hr/acre), down from 5.9 angler-hr/ha (2.4 angler-hr/acre) in 1993. Angling for walleye and bass accounted for 85% and 39% of all angling effort. The 1998 creel survey found that 99% of anglers were non-residents of Canada. Minnesota-based non-residents comprised 65% of all anglers, while non-resident cottagers and guests at Ontario resorts represented the remaining 35%. The total estimated angling effort in Minnesota waters during the openwater season in 1999 was 99,700 angler-hours, or 20.1 angler-hr/ha (8.1 angler-hr/acre). Most anglers were Minnesota residents living greater than 48 km (30 miles) from Namakan Lake. Only 5% identified themselves as "local anglers" living within 48 km.

Walleye

The walleye potential yield of 8,000 kg (17,700 lbs)/yr for Namakan Lake was divided between Ontario and Minnesota based on surface area (Figure 28). Ontario, with 51% of the lake area, has a potential yield of 4,100 kg (9,000 lbs)/yr while Minnesota's portion is 4,000 kg (8,700 lbs)/yr. The walleye potential yield of 0.80 kg/ha (0.71

lbs/acre) was determined using 32% of the total potential yield, for an angling dominated fishery. Previous estimates used a 30% partitioning since a commercial fishery for walleye still existed in Ontario waters.

Ontario

The annual walleye harvest averaged 2,900 kg (6,300 lbs)/yr which was well below the potential yield level, and the revised management objective of 3,500 kg (7,700 lbs)/yr (Figure 28). This has been set at 85% of the potential walleye yield, in order to assist population recovery and improve fishing quality. The average commercial walleye harvest of 1,500 kg (3,200 lbs)/yr during 1997–2002 represented 50% of the Ontario harvest, with the remaining 1,400 kg (3,100 lbs)/yr taken by the angling fishery (Figure 28). Based on the 1998 creel survey, 64% of the angling harvest or 32% of the total Ontario harvest was taken by Minnesota-based non-resident anglers. There was no reported subsistence harvest from this lake.

Recent assessments indicated that walleye stock abundance was depressed and signs of overharvest were evident. Walleye catches during FWIN assessment netting in year 2000 averaged 7.6 fish/net, slightly below average abundance estimates for northwestern Ontario lakes. Mean age of the catch was 3.4 years, with only 7 age classes represented by more than one fish, and a maximum age of 11 years. The age composition of the FWIN catch was dominated by two and four-year-old fish from strong 1998 and 1996 year-classes. There were very few fish over age 7 and 50 cm (19.5 inches), while older, mature fish, especially females, were almost completely absent from the fishery. It would appear that previous levels of harvest, approaching 17,100 kg (37,700 lbs)/yr, or 1.69 kg/ha (1.51 lbs/acre) during the period 1990–96, were high enough to produce changes in the abundance, size and age structure of the population, but not enough to immediately threaten recruitment. Approximately 85% of the angling effort on Namakan Lake targeted walleye, with release rates estimated at 47%. Walleye angling catch rates (CUEs) have declined only slightly and were estimated at 0.49 fish caught/angler-hr in 1998, which still represents good quality fishing in Ontario. However, the size composition of the angling catch was dominated by small fish, with over 66% comprised of 4-year-old fish from the strong 1994 year-class. Although age groups 2 to 9 years were present, very few fish over age 6 and 46 cm (18 inches) were sampled. The 1999 size regulation, which allows the harvest of only one walleye greater than 46 cm (18 inches), may have limited impact on this fishery.

Minnesota

The total estimated walleye harvest from Minnesota waters of Namakan Lake averaged 3,100 kg (6,900 lbs)/yr during 1998–1999 (Figure 28). This represents a decline from the 1990–1996 harvest estimate of 9,400 kg (20,700 lbs)/yr, and was likely related to the new size regulation. The current harvest estimate was below the predicted potential yield and management target of 3,900 kg (8,700 lbs)/yr.

The walleye gill net catch during large lake test netting in 2002 averaged 8.3 fish/net, which was above the long-term median of 6.9 (N=28) for Namakan Lake. The abundance of walleye greater than 43 cm (17 inches) increased from previous assessments. Nine year-classes were present in the walleye catch, with ages from zero to 8 years present. Strong year-classes were formed in 1996, 1998, and 2001. Walleye growth in Namakan Lake was below area and statewide averages. Sixty-six percent of those interviewed during the 1999 creel survey were fishing for walleye, while 5% were targeting smallmouth bass, and 14% were fishing for multiple species. The most common combination was fishing for walleye and northern pike.

Northern Pike

The potential yield for northern pike was estimated at 6,300 kg (13,800 lbs)/yr, with 3,200 kg (7,000 lbs)/yr from Ontario and 3,100 kg (6,800 lbs)/yr from the Minnesota portion of Namakan Lake (Figure 29).

Ontario

The total annual northern pike harvest in Ontario averaged 900 kg (2,000 lbs)/yr during 1997–2002 (Figure 29), down slightly from an average harvest of 1,300 kg (2,900 lbs)/yr from 1990–96. The commercial and angling fisheries comprised 800 kg (1,700 lbs)/yr and 100 kg (300 lbs)/yr, while no subsistence harvest was reported. Total harvest was well below both the potential yield and the recommended management objective of 2,700 kg (6,000 lbs)/yr. This was set at 85% of the potential yield level, in order to help population recovery and improve angling quality. The Ontario commercial fishery was eliminated in 2002.

The northern pike population appeared to be producing at a level well below potential during recent assessments. A mean FWIN catch of only 1.2 pike/net in 2000 indicated a relatively low abundance of northern pike, compared to Rainy and Sand Point lakes. Age compositions were limited to age groups from one to five years, with 3-year-old fish representing 40% of the total catch.

Angling success rates were poor, averaging less than 0.11 fish caught/angler-hr in 1998. Very few pike were kept by anglers. Low water levels at the time of pike spawning, due to a delay in spring peaking, may have contributed to a lack of suitable spawning habitat and limited recruitment.

Minnesota

The northern pike harvest from Minnesota waters averaged 1,900 kg (4,200 lbs)/yr during 1998–1999, which was below the target yield of 2,600 kg (5,800 lbs)/yr (Figure 29). The target was set at 85% of the potential yield, in order to promote a quality northern pike fishery.

Northern pike abundance has steadily increased on Namakan Lake since the early 1990s. The mean catch of northern pike in 2002 test nets was 2.0 fish/net which was above the lake class median of 1.5 fish/net. Sampled northern pike ranged from 45–94 cm (17.6–37.0 inches), with a mean length of 63 cm (24.6 inches). Northern pike grew faster than most other populations in International Falls area lakes. Lengths of northern pike harvested during the 1999 creel survey ranged from 48–70 cm (18.8–27.9 inches), with a mean length of 65 cm (25.5 inches). Although the daily catch and possession limit was six northern pike, no one who was interviewed had harvested more than two.

Smallmouth Bass/Black Crappie

The potential yield of smallmouth bass and black crappies combined (centrarchids) for the Ontario and Minnesota portions of Namakan Lake was estimated at 2,500 kg (5,400 lbs)/yr and 2,400 kg (5,200 lbs)/yr, respectively (Figures 30 and 31). Low crappie yields in the past probably reflect limited productivity for crappies in this lake. Potential yield was partitioned at 16% for smallmouth bass and 3% for black crappie, based on the long-term proportion of harvest by species. This has resulted in a potential yield estimate of 2,000 kg (4,500 lbs)/yr for bass and 400 kg (900 lbs)/yr for crappie in Ontario, and 2,000 kg (4,300 lbs)/yr for bass and 400 kg (900 lbs)/yr for crappie in Minnesota waters.

Ontario

The angling harvest of smallmouth bass remained unchanged at 500 kg (1,200 lbs) in 1998 (Figure 30), even though effort for bass has increased considerably since 1993. Harvests were below the management objective of 1,000 kg (2,300 lbs)/yr, which was set at 50% of the potential yield to help maintain angling quality. Minnesota-based non-residents accounted for 64% of the harvest, with Ontario-based non-

residents anglers harvesting the remainder (Figure 30). Angling success for smallmouth bass remained high at 0.8 fish caught/angler-hr in 1998, up from 0.61 fish caught/angler-hr in 1993. Abundance in FWIN gill nets averaged 1.5 bass/net in 2000, which was similar to catch rates in the North Arm of Rainy Lake.

The black crappie harvest was almost non-existent, with only trace amounts reported from the commercial fishery (Figure 31). The management objective has been set at the potential yield level of 400 kg (900 lbs)/yr.

Minnesota

The average smallmouth bass harvest (Figure 30) from Minnesota waters during 1998–1999 was 1,100 kg (2,300 lbs)/yr, above the target of 1,000 kg (2,100 lbs)/yr, but below the potential yield of 2,000 kg (4,300 lbs)/yr. A conservative target was set at 50% of the potential yield, in order to promote a quality bass fishery on Namakan Lake. Smallmouth bass were second only to walleye in popularity, as measured by the number of anglers targeting this species. Although gill net catches of smallmouth bass in Namakan Lake have tended to be variable, recent data has indicated an increasing trend in abundance since the early 1960s. Stock status information is limited because no other sampling methods have been used on Namakan Lake. The target will remain at 1,000 kg (2,100 lbs)/yr.

The average black crappie harvest was 300 kg (800 lbs)/yr during 1998–1999, slightly below the target and potential yield of 400 kg (900 lbs)/yr. Stock status information is limited for this species in Namakan Lake. The target will remain unchanged (Figure 31).

Other Species

The potential yield for lake whitefish has been estimated at 3,100 kg (6,800 lbs)/yr for the Ontario side and 3,000 kg (6,500 lbs)/yr for the Minnesota portion, for a combined total of 6,100 kg (13,300 lbs)/yr for Namakan Lake (Figure 32).

The potential yield of lake sturgeon (Figure 33) was estimated at 100 kg (220 lbs)/yr for each of the Ontario and Minnesota portions of the lake, based on a long-term yield estimate of 0.04 kg/ha for the surface area of water less than 12.2 m (40 ft).

Ontario

The average commercial harvest of lake whitefish from Ontario was 2,000 kg (4,300 lbs)/yr in 1997–2002, compared with the 1990–1996 average of 3,300 kg (7,400 lbs)/yr. This harvest level exceeded the revised management objective of 1,500 kg (3,400 lbs)/yr that was set at 50% of

the potential yield, to counter possible declines in whitefish populations from introduced rainbow smelt and high winter drawdown of lake levels. Smelt may have a negative impact on whitefish and cisco recruitment, as a result of competition and predation. However, whitefish populations are expected to improve with the elimination of the commercial fishing licence in 2002, and positive changes to the water level rule curve in 2000.

The 1997–2002 commercial harvest of **lake sturgeon** in Ontario averaged 200 kg (520 lbs)/yr, with no harvest reported since 1999 (Figure 33). The current harvest level exceeded the revised management objective of 60 kg (140 lbs)/yr, based on a safe harvest level of 0.025 kg/ha for the lake surface area shallower than 12.2 m. Annual commercial harvests during 1924–1999 peaked in 1960 at 2,200 kg (4,800 lbs)/yr, but averaged 400 kg (900 lbs)/yr over the long term. No estimates of subsistence or angling harvest were available. A total of eight lake sturgeon were captured in FWIN gill nets in year 2000, for a mean catch of 0.3 fish/net. Fish ranged in age from 6 to 27 years. The only commercial fishing licence for sturgeon was eliminated by Ontario in 2002.

Minnesota

The average commercial harvest of **lake whitefish** in the Minnesota waters of Namakan Lake was 100 kg (200 lbs)/yr from 1997 to 2002. In 2002, activity and harvest under this licence increased to 400 kg (800 lbs). One commercial licence for lake whitefish remains, although burbot, cisco, and white sucker are also taken. This licence cannot be transferred or passed down. A conservative target harvest of 1,500 kg (3,300 lbs)/yr has been established to promote recovery of whitefish stocks.

Lake sturgeon harvest in Minnesota waters is assumed to be zero, although anecdotal reports suggest that anglers do occasionally catch and harvest these fish. Lake sturgeon have been sampled annually during gill net surveys on Namakan Lake, but in low numbers (i.e. 0.05 fish/net). Targeted sampling with appropriate gear is needed to learn more about the status of lake sturgeon stocks in Namakan Lake. The target harvest of 60 kg (130 lbs)/yr was based on an estimate of 0.025 kg/ha and the lake surface area less than 12.2 m (40 ft).

Sand Point Lake Fishery Resource

Lake Description

Sand Point Lake, located on the Ontario–Minnesota border, encompasses an area of 3,600 ha (8,900 acres), with 58% or 2,100 ha (5,200 acres) in Minnesota and 42% or 1,500 ha (3,700 acres) in Ontario. This mesotrophic lake lies within the Canadian Shield, and the southern range of the boreal forest in North America. Its waters are soft and submergent vegetation is sparse, except in the shallower portions of bays. Sand Point Lake has the following characteristics: 32% of the lake consists of littoral area; a mean depth of 11.9 m (39 ft) and a maximum depth of 56.1 m (184 ft); greatest length of 13 km (8 miles); shoreline length of 148 km (92 miles) with approximately 96 islands; mean summer secchi disk reading of 2.2 m (7.2 ft). The lake turns over or mixes in both the early spring and late fall (dimictic), with stratification usually lasting from late May to late October. The summer thermocline is located at 8 to 10 m (26 to 33 ft), and mean surface temperatures are about 20°C (68°F) during the summer.

Sand Point Lake is also part of the Namakan Reservoir. Consequently, it experiences the same water level fluctuations as Namakan Lake and the other basins (see Namakan Lake). The water level management system which had been in place since 1970 was shown to adversely affect the aquatic ecosystem. It was subsequently revised by the International Rainy Lake Board of Control and the International Joint Commission in January 2000.

Historically, access to Sand Point Lake was by water from Crane Lake. Flanders Road in Ontario has opened up access to both Namakan and Sand Point lakes via the Namakan River. Development on the Ontario side of Sand Point Lake consists of a tourism lodge, Canada Customs and Immigration point of entry, store, Boy Scout camp, and an estimated 38 cottages. The Minnesota side of the lake lies within Voyageurs National Park where there are a number of private properties and National Park campsites. A commercial fishery existed on the Ontario side of Sand Point Lake from 1971 to 2001, with quotas for lake whitefish, lake sturgeon, and black crappie, in addition to small incidental quotas for walleye and northern pike. This licence was eliminated through government purchase in 2002.

No new exotic species have been introduced or discovered since 1997. However, rainbow smelt have become firmly established in the Namakan Reservoir since they were first discovered in 1990.

Changes to Angling Regulations

Ontario

A number of management actions have been taken since 1997 to improve the status of fish stocks in Sand Point Lake. Several legislative or angling regulation changes have been implemented in Ontario, including size and catch limits for most species. In 1999, the daily catch and possession limit for walleye and/or sauger was reduced from six (6) to four (4), and the maximum size limit of one fish greater than 50 cm (19.5 inches) was reduced to one fish over 46 cm (18 inches). A protected slot and trophy size limit for northern pike were established that allow no pike to be kept from 70 to 90 cm (27.5 to 35.4 inches) total length with only one (1) fish over 90 cm. The daily catch and possession limit was reduced from six (6) to four (4) fish. A maximum size limit was also introduced for smallmouth and largemouth bass (in combination), that allowed only two (2) bass to be kept under 35 cm (13.8 inches) from December 1 to June 30 each year, with a daily catch and possession of four (4) fish during the remainder of the year. The daily catch and possession limit of black crappie for regular licence holders was also reduced from 30 to 15 fish. As a result of a pending NAFTA challenge, the catch limit of walleye for non-resident of Canada anglers was changed in 2000 to two (2) fish daily, and four (4) in possession, with only one (1) fish over 46 cm (18 inches).

Minnesota

A new walleye size regulation was implemented on Minnesota's portion of Namakan Reservoir including Sand Point Lake in 1998. The new regulation allows anglers to harvest walleye greater than 33 cm (13 inches) or less than 43 cm (17 inches). In addition, only one (1) walleye greater than 58 cm (23 inches) can be kept in a daily and possession limit of six (6). This experimental regulation will expire March 2007. The black crappie daily and possession limit of 30 was reduced to 10 in May 2003.

Current Fish Stock Status

Potential fish yields, as determined by the morphoedaphic index (MEI), were divided on the basis of the lake surface area in each jurisdiction. The total potential fish yield for all fish species from Sand Point Lake is 2.90 kg/ha (2.58 lbs/acre) or 10,400 kg (22,900 lbs)/yr. Ontario's portion, with 42% of the total lake surface area, is 4,400 kg (9,700 lbs)/yr while Minnesota's is 6,000 kg

(13,200 lbs)/yr. The average annual harvest estimate for all species from 1997–2002 was 2.06 kg/ha (1.82 lbs/acre), or 7,400 kg (16,200 lbs)/yr.

Angling effort in the Ontario portion of Sand Point, Little Vermilion and David Lakes in 1998 was estimated at 16,500 angler-hr, or 9.2 angler-hr/ha (3.7 angler-hr/acre), a decline from 26,300 angler-hr or 12.5 angler-hr/ha (5.1 angler-hr/acre) in 1993. The majority of angling effort was for walleye (82%), while smallmouth bass and northern pike were secondary. The 1998 creel survey on the Ontario portion of Sand Point Lake found that 99% of all interviewed anglers were non-residents of Canada. Minnesota-based non-residents comprised 57% of the anglers in Ontario waters, while owners of cottages in Ontario and guests at Ontario resorts comprised the remaining 42%.

The total estimated angling effort in Minnesota waters of Sand Point Lake during the openwater season in 1999 was 50,731 angler-hr, or 24.2 angler-hr/ha (9.8 angler-hr/acre). Forty-eight percent of those interviewed were fishing for walleye, 21% were fishing for "no particular species", 21% were fishing for northern pike and walleye combined, 6% were targeting smallmouth bass, 3% were fishing for northern pike, and 1% were targeting black crappie. Most anglers (66%) were Minnesota residents living further than 48 km (30 miles) from Sand Point Lake. Less than 4% lived within 48 km. Thirty-one percent of the anglers interviewed were non-residents of Minnesota.

Walleye

The potential annual yield of walleye from Sand Point Lake was estimated at 3,400 kg (7,500 lbs)/yr (Figure 28). Ontario's portion, with 42% of the lake surface area, is 1,400 kg (3,100 lbs) while Minnesota's is 2,000 kg (4,400 lbs). Walleye potential yield, expressed as 0.93 kg/ha (0.83 lbs/acre)/yr, was derived from a 32% partitioning of the total potential fish yield for an angling dominated fishery.

Ontario

The total annual walleye harvest from Ontario waters was estimated at 1,200 kg (2,600 lbs)/yr (Figure 28), of which anglers accounted for 1,100 kg (2,500 lbs)/yr while the commercial fishery took the remainder. This average harvest was identical to that previously reported for the 1990–96 period. It also equals the recommended management objective of (1,200 kg or 2,600 lbs/yr) which was set at 85% of the potential walleye yield, in order to allow for continued population recovery and fishing quality. An estimated 54% or 600 kg

(1,300 lbs)/yr of the Ontario harvest was taken by Minnesota-based non-resident anglers, while 39% was harvested by Ontario-based anglers (Figure 28). There was no reported subsistence harvest of walleye during this period.

Recent assessments would suggest that walleye stock abundance was slightly higher, and the population showed fewer signs of stress than walleye in Namakan Lake. A mean catch of 10.5 walleye/net was observed in year 2000 FWIN samples. The mean age of the catch was higher at 4.2 years, with 10 age classes represented by more than one fish. Maximum age was 23 years. The age composition of the 2000 FWIN catch was dominated by two and 4-year-old fish from the 1998 and 1996 year-classes. Compared to Namakan, there was a much better representation of fish older than age 7, and larger than the current Ontario maximum size limit of 46 cm (18 inches). Approximately 82% of angling effort on Sand Point Lake in 1998 targeted walleye, with release rates reported at 41%. Although the mean angling catch rate of 0.24 walleye caught/angler-hr was low in comparison to Namakan Lake, the size composition of the angling catch consisted of larger fish. The mean total length was 36 cm (14 inches) while 9% of the angler catch was greater than 46 cm (18 inches). Although the majority (49%) of the angling catch was comprised of 4-year-old fish from the strong 1994 year-class, fish aged 2 to 11 years were present.

Minnesota

The total estimated walleye harvest from Minnesota waters of Sand Point Lake in 1998 and 1999 averaged 2,200 kg (4,900 lbs)/yr (Figure 28). This represented a decline from previous harvest estimates of 3,100 kg (6,900 lbs)/yr, and was likely related to implementation of the new 33 to 43 cm (13–17 inches) walleye harvest slot. The target was set at 100% of the predicted walleye potential yield or 2,000 kg (4,400 lbs)/yr.

Annual gill netting of Sand Point Lake produced a mean catch of 6.2 walleye/net in 2002, slightly below the median for Class 2 lakes in the Minnesota large lake sampling program. Thirteen walleye year-classes from one to 13 years were present in the catch. The mean total length was 35 cm (13.7 inches) within a range of 18 to 68 cm (7.0–26.8 inches). Mean total length at age 4 was less than area and statewide averages.

Northern Pike

The potential yield for northern pike was estimated at 2,600 kg (5,800 lbs)/yr, with 1,100 kg (2,400 lbs) from the Ontario side and 1,500 kg (3,400 lbs) from the Minnesota portion of Sand Point Lake (Figure 29).

The northern pike population in Sand Point Lake, as in the other basins of Namakan Reservoir, has been subject to recruitment problems due to low spring water levels during the previous water level management regime. Studies have indicated that northern pike abundance is positively related to spring water levels. Spawning season water levels above 339.8 m (1,115 ft; above sea level) produce stronger year-classes.

Ontario

Northern pike harvest during 1997–2002 averaged 700 kg (1,500 lbs)/yr (Figure 29), which was similar to the previous estimate of 600 kg (1,300 lbs)/yr for 1990–1996. The majority of this harvest, 94% or 600 kg (1,400 lbs), was taken by anglers while less than 50 kg (100 lbs) was harvested incidentally by the commercial fishery. There was no reported subsistence harvest. FWIN netting in 2000 indicated a relatively low abundance of northern pike in Sand Point Lake, with a mean catch of 1.9 fish/net. A relatively high mean catch weight of 3.9 kg/net suggested better representation of larger, quality sized fish than in Namakan Lake. More age classes, from 2 to 7 years were represented, although older age classes were generally absent in both lakes. The 1998 angling success rate was 0.24 fish caught/angler-hr, with a 67% release rate. More anglers reported fishing specifically for pike in Sand Point Lake (29%) than in Namakan Lake (9%). The majority of pike were harvested by Minnesota-based (54%) and Ontario-based non-residents (39%).

Minnesota

The total estimated angling harvest of northern pike from Minnesota waters of Sand Point Lake averaged 900 kg (2,000 lbs)/yr during 1998–1999 (Figure 29), slightly below the target and long-term harvest average of 1,300 kg (2,900 lbs)/yr. The target was set at 85% of the potential yield (i.e. 1,500 kg or 3,400 lbs/yr), in order to improve the quality of the fishery. Recent assessments indicated that northern pike population abundance in Sand Point Lake is relatively low, with good growth. The annual test netting survey reported 1.6 pike/net in 2002, which was equal to the median for Class 2 lakes. Six year-classes were present from 2 to 7 years old. Fish from the catch averaged 62.5 cm (24.6 inches) within a range of 50 to 93 cm (19.7–36.6 inches). Anglers released most of the northern pike that they caught, and none of those interviewed had kept their daily catch limit of six fish. The lakes of Namakan Reservoir, including Sand Point Lake, have good potential for quality northern pike management.

Smallmouth Bass/Black Crappie

The potential yield of smallmouth bass and black crappie (centrarchid) combined for Sand Point Lake was estimated at 2,100 kg (4,500 lbs)/yr, with 900 kg (1,900 lbs)/yr for Ontario, and 1,200 kg (2,600 lbs)/yr for Minnesota waters (Figures 30 and 31). Crappies were present in greater numbers in Sand Point Lake, especially in Minnesota waters, than in Namakan Lake. Partitioning of the centrarchid yield for smallmouth bass (13%) and black crappie (6%) was based on the long-term proportion of harvest by species. This resulted in a potential yield of 600 kg (1,300 lbs)/yr for bass and 300 kg (600 lbs)/yr for crappie in Ontario waters, and 800 kg (1,800 lbs)/yr for bass and 400 kg (800 lbs)/yr for crappie in Minnesota portions of the lake. Total centrarchid harvest averaged about 700 kg (1,600 lbs)/yr in Ontario and 600 kg (1,300 lbs)/yr in Minnesota during 1997–2002.

Ontario

The angling harvest of **smallmouth bass** had increased by 50% to an estimated 700 kg (1,500 lbs) in 1998 (Figure 30), which was consistent with an increase in targeted effort for smallmouth bass since 1993. This harvest level was well above the management objective of 300 kg (700 lbs)/yr, which had been set at 50% of the potential bass yield to help maintain angling quality. Abundance of bass in FWIN gill nets during 2000 averaged only 0.8 fish/net, which was lower than in Namakan Lake. The angling success rate for smallmouth bass was 0.52 fish caught/angler-hr in 1993 and 0.57 fish caught/angler-hr in 1998. The majority of the bass angling harvest was taken by Minnesota-based (57%) and Ontario-based non-residents (42%).

Harvest of **black crappie** was almost non-existent in Ontario waters during 1997–2002, with only 50 kg (100 lbs)/yr reported from the commercial fishery. Crappie angling success was low, averaging 0.1 fish caught/angler-hr during the 1998 openwater fishery. No harvest or effort data were available from the winter fishery. The management objective has been set at the potential yield level of 300 kg (600 lbs)/yr for this species.

Minnesota

Although **smallmouth bass** were second only to walleye in numbers caught during the 1999 creel survey of Minnesota waters, only 14% of the catch was reportedly harvested. The average total harvest in 1998 and 1999 was 1,000 kg (2,100 lbs)/yr, which exceeded the target of 400 kg (900 lbs)/yr. The target harvest level was set at 50%

of the potential yield, in order to maintain and improve quality bass fishing opportunities in Sand Point Lake. The mean length of bass harvested in 1999 was 35.6 cm (14 inches). Stock status information was limited, owing to difficulties in accessing Sand Point Lake.

The average **black crappie** harvest in 1998 and 1999 was 200 kg (500 lbs)/yr, which was below the target of 400 kg (800 lbs)/yr (Figure 31). Fish sampled from the angling catch in 1999 averaged 26 cm (10.2 inches) in length and 5.5 years old, with four age classes represented.

Other Species

The potential yield for **lake whitefish** was estimated at 1,000 kg (2,300 lbs)/yr for the Ontario side and 1,500 kg (3,300 lbs)/yr for Minnesota waters, for a combined total of 2,500 kg (5,600 lbs)/yr for Sand Point Lake (Figure 32).

The potential yield estimate of **lake sturgeon** (Figure 33) was 40 kg (80 lbs)/yr for Ontario and 50 kg (120 lbs)/yr for Minnesota waters, based on a long-term yield estimate of 0.04 kg/ha for the lake surface area less than 12.2 m (40 ft).

Ontario

The average commercial harvest of **whitefish** from Ontario was 400 kg (800 lbs)/yr for 1997–2002, compared with the previous average of 700 kg (1,500 lbs)/yr from 1990–1996. This level of harvest was below the revised management objective of 500 kg (1,200 lbs)/yr (Figure 32) or 50% of the total whitefish potential yield. The management objective for Ontario has been reduced to help restore a healthy whitefish population. Management objectives were reduced by both jurisdictions on the lake as a proactive measure to counter possible declines in whitefish associated with introduced rainbow smelt and high water level drawdown during winter. Whitefish populations are expected to improve with the elimination of the commercial licence in 2002 and with positive changes to the water level rule curve in year 2000.

The 1997–2002 average commercial harvest of **lake sturgeon** in Ontario was 70 kg (160 lbs)/yr, with no harvest reported since 1999 (Figure 33). No estimates of subsistence and angler harvest were available. The current harvest level exceeded the revised management objective of 20 kg (50 lbs)/yr, based on a safe harvest level of 0.025 kg/ha for the lake surface area shallower than 12.2 m (40 ft). However, the only commercial fishing licence was eliminated by Ontario in 2002. A total of four sturgeon were captured in FWIN gill nets in 2000, for a mean catch rate of 0.2 fish/net. Fish ranged in age from 14 to 35 years old.

Minnesota

Yellow perch and sauger were harvested by anglers from Sand Point Lake in low numbers, usually less than 50 kg (100 lbs)/yr each. Lake sturgeon harvest in Minnesota waters was assumed to be zero, although anecdotal reports suggest that anglers do occasionally catch and harvest them. Lake sturgeon have been sampled in annual gill net surveys on Sand Point Lake, but in low numbers. Targeted sampling with appropriate gear will be required, in order to learn more about the status of this species in Sand Point Lake. The target harvest for lake sturgeon has been set at 30 kg (70 lbs)/yr, based on a safe harvest level of 0.025 kg/ha for the lake surface area shallower than 12.2 m (40 ft).

Resource Use

Lake of the Woods/ Rainy River

Socio-Economic Infrastructure

History of Use

Local First Nations people have depended on the Lake of the Woods/Rainy River fishery as a source of food for thousands of years. Major rapids at Manitou and Long Sault on the Rainy River became significant cultural sites for First Nations people who came from hundreds of kilometres around to harvest spring spawning sturgeon and walleye. A non-aboriginal commercial fishery developed during the late 1880s on both the United States and Canadian sides of the lake. The recreational fishery has become internationally known in the last 70 years.

Local Communities and Population

Over 33,000 people live around Lake of the Woods and most have varying degrees of interest in or dependence on the fishery. About 72% of the local population resides in Ontario. Residents live in organized municipalities, rural townships, in First Nations communities (Indian Reserves), and in unorganized areas. Sixty-five percent of the Ontario population lives in Kenora, 14% in other organized areas, 7% in unorganized areas, and 14% in First Nations communities (Table 1). In Minnesota, 34% of local residents live in municipalities, 30% in unorganized territories, while another 36% of the local population resides in rural townships (Table 2). The population on the Ontario side increased by 7% since the 1998 Atlas. Minnesota experienced a 9% growth in population within the study area between the 1990 and 2000 censuses. The largest expansion occurred in Ontario First Nations communities and within the rural townships of Lake of the Woods and Roseau counties in Minnesota.

Economic Base

The economy of the Lake of the Woods area is heavily oriented to forest products, tourism, fishing, transportation, mining, public, and commercial services. The major industrial employers are Abitibi-Consolidated Company of Canada, Trus-Joist Weyerhaeuser, Canadian Pacific Railway, Kenora Forest Products and Devlin Timber (Kenora), Voyageur Panel (Barwick), Canadian National Railway (Rainy River), Solvay Pharmaceuticals (Baudette), Marvin

Table 1. Ontario population in the Lake of the Woods/Rainy River study area (2001 Census).

Organized Municipalities (2001)	Population
Kenora	15,838
Sioux Narrows/Nestor Falls Twp.	577
Lake of the Woods Twp.	330
Rainy River	981
Chapple	910
Dawson Twp.	631
Sub Total	19,249
First Nation Communities on-reserve residents (Indian and Northern Affairs Canada 2002)	Population
Big Grassy	287
Big Island	153
Buffalo Point (Manitoba)	42
Dalles	138
Northwest Angle 33	190
Northwest Angle 37	144
Rainy River	253
Rat Portage	335
Sabaskong	510
Shoal Lake 39	324
Shoal Lake 40	246
Washagamis Bay	159
Whitefish Bay	715
Sub Total	3,496
Unorganized Areas (1986 Census) (approx.)	1,800
Total	24,545

Windows, and Christian Brothers Hockey Sticks (Warroad).

In Ontario, angling and commercial fishing on Lake of the Woods make an important contribution to the local resource based economy. The fishery is of particular economic and social importance to people who live outside of the larger centres, especially on First Nations and other small communities such as Morson, Nestor Falls, and Sioux Narrows. For many other local residents of Ontario, angling provides a recreational opportunity not readily available in comparable quality in most other localities, and makes a significant contribution to the quality of life in the Lake of the Woods area.

In Minnesota, angling (tourism) generates the

largest economic return to Lake of the Woods County, and is a major contributor to the economy in Roseau County. Angling is presently providing a steadily increasing job base and year-round employment with the expansion of the winter fishery. The fishery provides significant economic and social contributions to the residents that live along the south shore of Lake of the Woods and the Rainy River. Angling is the number one recreational activity for residents of this area and contributes to the quality of life.

Users of the Fishery

Commercial Fishers: the following two groups are recognized under this category:

- **Aboriginal Fishers:** First Nations people with Treaty 3 status living in Ontario who fish for commercial and domestic purposes (subsistence) under the authority of a commercial fishing licence;
- **Non-aboriginal Fishers:** All other commercial fishermen fishing under the authority of a commercial fishing licence.

Anglers: The following are included in this category:

- **Resident (local) anglers:** Minnesota and Ontario residents living in the immediate study area and fishing in their own jurisdiction. (All

Table 2. Minnesota population in the Lake of the Woods/Rainy River study area. Data from the 2000 U.S. census.

Lake of the Woods and Roseau Counties	Population
Municipalities	
Baudette	1,104
Roosevelt	166
Warroad	1,722
Williams	210
Sub Total	3,202
Rural Townships	
Lake	2,087
Baudette	357
Moranville	940
Sub Total	3,384
Unorganized Territories	
Northwest Angle	152
Rainy River	2,616
Sub Total	2,768
Total	9,354

Angling Effort

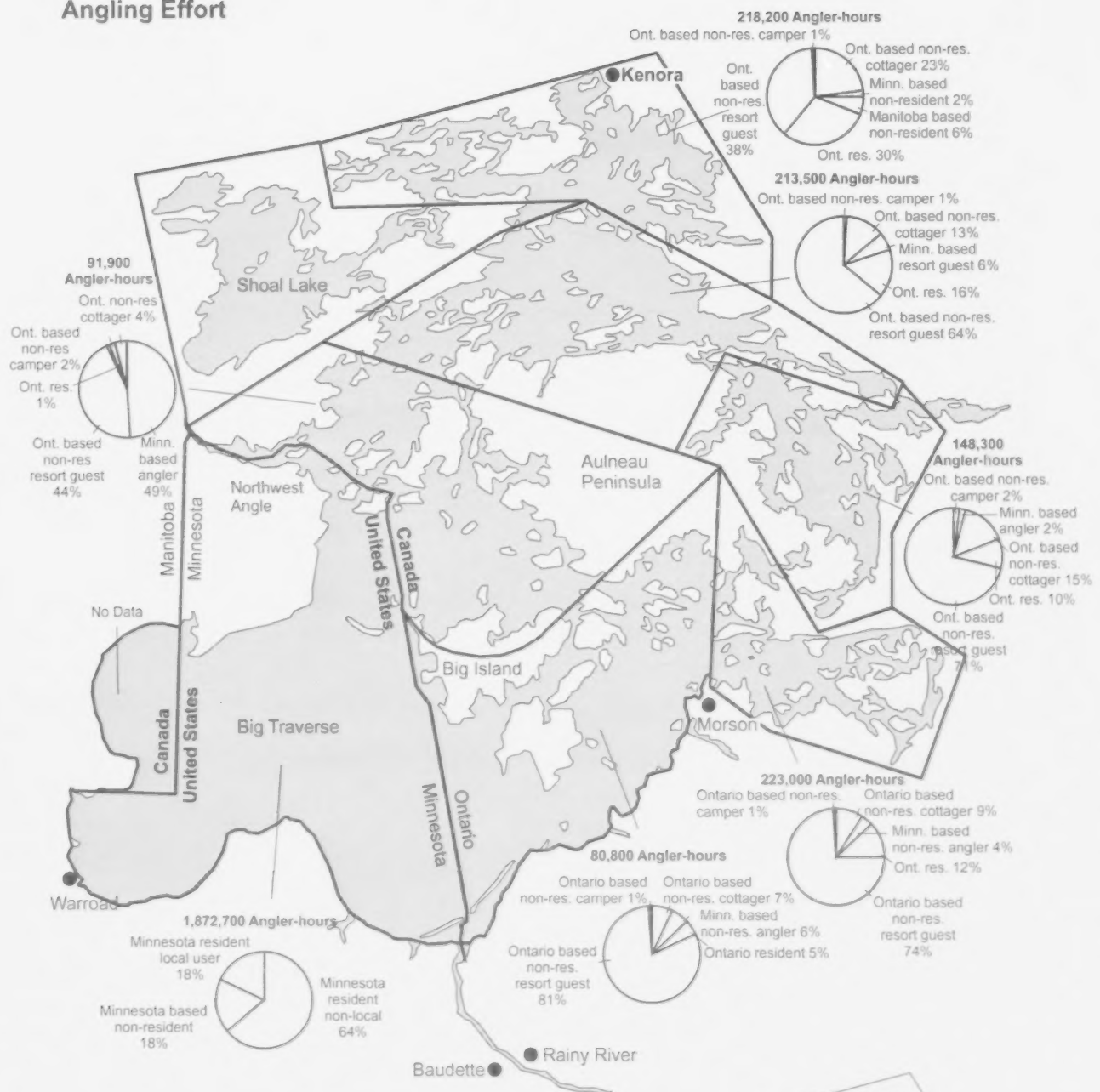
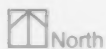


Figure 34. Lake of the Woods/Rainy River
 Angling effort by user group 1997-2002.

0 5 10 Kilometres
 0 3 6 Miles



Ontario resident anglers are considered locals.)

- **Resident (non-local) anglers:** Minnesota residents from outside the study area fishing in their own jurisdiction.
- **Non-resident/non-local resort guests:** Anglers using local commercial tourist accommodation operations including lodges, campgrounds, and houseboats.
- **Non-resident property owners:** Anglers based at cottages owned by non-residents of the local area; usually the owner and immediate family.
- **Non-resident (non-local) campers:** Includes Lake of the Woods anglers who live outside the jurisdiction but who camp on public or Crown land, and Ontario provincial parks.
- **Manitoba-based anglers:** Includes fishers, primarily residents of Manitoba, based in Manitoba and fishing in Ontario or Minnesota waters on a day-use basis.
- **Minnesota-based anglers:** Includes fishers based in Minnesota and fishing in Ontario waters on a day-use basis.

User Profiles

Commercial Fishing

Aboriginal Fishers: The long-term trend in Ontario's commercial fishery on Lake of the Woods has been towards retirement of non-aboriginal commercial licences and recognition of the interest of First Nations communities in the fishery. All First Nations on Lake of the Woods fish commercially with the exception of Washagamis Bay and Rainy River First Nation. Most of these fisheries are recognized as band, or community fisheries. Licences are usually fished by many families with a range of age and experience.

While most effort is expended on fishing for commercial sale rather than for domestic use, fishing for personal consumption also occurs during commercial fishing activities. Fishing for personal use has a traditional significance in First Nations communities that is still valid today. Most commercial fishing in Ontario waters is done with gill nets.

Non-Aboriginal Fishers: In the early 1980s, Ontario began a "willing seller-willing buyer" program to retire non-aboriginal commercial fishing licences. The last non-aboriginal commercial fishery was retired in December 2002. However, harvest summaries in this atlas include harvests from both aboriginal and non-aboriginal fishing operations that were carried out by an individual or family group, with the assistance of

friends, relatives, or hired fishers. Fishing activity was concentrated mainly in the fall, and to a lesser extent in May and June, and in the winter. Fishers receive premium prices for their catch during the winter season. Most commercial fishing in Ontario waters is done by gill netting.

Anglers

Resident Anglers: Angling is a very important recreational activity for local residents. In about three-quarters of local households in Ontario, at least one person fishes on Lake of the Woods once or more per year (Hough *et al.* 1982).

The North Sector, which is closest to the Kenora-Keewatin population centre, is the most heavily fished area by local Ontario residents (i.e. 30% of total effort for this sector; Figure 34). The Central Sector is the second most frequently fished area on Lake of the Woods by this group (i.e. 16% of total), followed by Sabaskong Bay (12%) and Whitefish Bay (10%). Comparatively little angling activity occurs on the South Sector 5 (5%) and South Sector 6 (1%) by Ontario residents.

Local residents of Lake of the Woods/Rainy River in Minnesota account for approximately 18% of the total recreational fishery in Minnesota waters during the openwater season. Non-local Minnesota residents were responsible for 64% of this activity (Figure 34). Local residents and non-local residents account for 23% and 62% of winter angling activity.

Non-Resident/Non-Local Resort Guests: Within the immediate study area are 126 tourist operations, 39 of which are in Minnesota. Estimates of occupancy rates for these establishments range from 45 to 63% (seasonal) in Ontario and 65% (year-round) in Minnesota.

There are 87 tourist accommodation operations in Ontario, dependent on fishing Lake of the Woods/Rainy River (Panell *et al.* 2003). These operations obtain more than 25% of their gross revenue from angling activity on the lake and include main base, outpost camp, campground, and houseboat accommodations. Approximately 80% of all guests are anglers who fish primarily on Lake of the Woods. About 90% of these are from the United States, especially the mid-West. The balance are from Manitoba, other parts of Canada, or other countries (e.g. Germany).

Non-Resident Property Owners: Cottage-based angling is an important component of the recreational fishery on Lake of the Woods. Of the estimated 6,000 cottage lots on Lake of the Woods, Ontario, some 1,200 are owned by local residents, 2,100 are owned by residents of the

United States, and the remaining 2,700 are owned by residents of Manitoba. Manitobans account for the majority of non-resident property owners, especially on Shoal Lake and the North Sector. Over 300 cottages are located on Lake of the Woods in Minnesota.

The majority (91%) of local cottagers fish at least once a year. Non-resident property owners accounted for 23% of the total angling effort in the North Sector, 13% in the Central, 15% in Whitefish Bay, 9% in Sabaskong, and approximately 7% and 4% of the total angling effort in South Sectors 5 and 6, respectively during recent creel surveys (Figure 34).

Non-Resident Campers: Non-resident campers on Ontario Crown land and provincial parks represented a minor component of the overall angling fishery on Lake of the Woods/Rainy River. This group contributed less than 1% of all angling effort in most sectors, except for Whitefish Bay and South Sector 6 where they represented about 2% of the estimated angling effort during recent creel surveys (Figure 34).

Manitoba-Based Anglers: Although a trend to increased use of Kenora district waters by Manitoba-based anglers has continued, this group was present only in the North Sector during recent surveys, representing about 6% of total angling activity in this area.

Minnesota-Based Anglers: The use of Ontario's portion of Lake of the Woods by Minnesota-based charter boats, houseboats, and smaller boats owned by both local area residents and tourist resort guests is an important component of the recreational fishery. The relative use of Minnesota and Manitoba waters by Ontario residents is small.

Minnesota-based anglers accounted for a substantial portion of total angling effort in those Ontario sectors that border directly with Minnesota, representing 6% of total effort in the Central Sector and Sector 5, and 49% of angling effort in Sector 6. Minnesota-based anglers also represented 2% of total angling effort in the North Sector and Whitefish Bay, and 4% of angling effort in Sabaskong Bay (Figure 34). Effort by Minnesota-based anglers in Ontario waters has grown following cancellation of the Border Waters Conservation licence program in 2000 but remains lower than pre-1985 use levels.

Estimate of Socio-Economic Benefits

Economic Analysis

Approximately \$78.2 million (2002 Canadian dollars) in gross operation revenues are generated annually by the Lake of the Woods fishery. This fishery produced about \$33.6 million in gross operation revenues in the local area of Ontario and \$44.6 million in Minnesota (Anonymous 1996). Angling by non-resident Ontario resort guests accounts for some 90% of the gross economic return from the Lake of the Woods fishery in Ontario, commercial fishing 3%, and other uses 7%. Other uses include angling by local residents, non-resident property owners, etc. In Minnesota, the angling fishery generates almost all of the economic return.

A recent study of the economic impacts of tourism in Lake of the Woods, Ontario (Pannell *et al.* 2003) found that tourism expenditures from both operational and capital expenditures generated \$98 million in economic activity, 65% of which (\$64 million) was retained within the local area. The non-resident resort guest fishery on the Ontario portion of Lake of the Woods generated an estimated \$30.1 million in direct revenues in 2002.

OMNR estimated that the Lake of the Woods commercial fish harvest in Ontario had a dockside value of \$731,020 based on the average reported harvest of walleye, northern pike, crappie, whitefish, and sturgeon, and reported catches of non-quota species (sauger, yellow perch, etc.) during 1997–2002. In addition, fish taken by First Nations people for domestic use was estimated to have a value of \$264,590.

The South sectors commercial fishery accounted for almost 74% of the total value of the Ontario Lake of the Woods commercial fishery. The North, Central, and Shoal Lake fisheries accounted for the remaining 26% of the estimated value in 2002.

Social Analysis

Social benefits are difficult to translate into dollars but are, nonetheless, important to the welfare of the local community. They include the number and type of jobs created, along with recreational opportunities provided by the Lake of the Woods fishery.

A recent analysis of economic impact (Pannell *et al.* 2003) indicated that tourism in the Lake of the Woods region supported 2,500 equivalent full-year jobs. About 16.9% of these were provided by First Nations. Job opportunities for First Nations people from the Ontario fishery are important, especially in terms of commercial fishing and guiding.

In Minnesota, approximately 1,109 were employed at tourist accommodation operations in 1994. Jobs at the tourist operations have become less seasonal and more permanent with the expansion of the winter fishery.

Future Demands on the Fishery

Commercial Fishing

The long-term trend in the Ontario commercial fishery on Lake of the Woods, has been toward the retirement of non-aboriginal commercial fisheries and the recognition of the interest of First Nations communities in commercial fishing.

Overall, recent retirements of non-aboriginal commercial fisheries have reduced commercial harvests of walleye and northern pike, while harvests of other species such as whitefish, yellow perch, black crappie, and sauger have increased with the development of new markets and changing fishing practices.

The long-term need to accommodate employment and domestic needs of First Nations communities remains a high priority in the management of this fishery. All non-aboriginal commercial fishing licences were retired by OMNR on Lake of the Woods in December 2002.

On the Minnesota portion of the lake, all commercial gamefish licences and quotas were purchased by 1986. The gamefish were allocated to the angling fishery with the buy-out.

Angling

Angler demand in Ontario waters is anticipated to steadily increase, based on traditional growth of non-resident angling in northwestern Ontario, and on an aging North American population with increased leisure time and disposable income.

Future growth of tourist clientele will depend heavily on the ability of the tourism industry to provide a high quality experience, not only in terms of number and size of fish caught, but also in the type and quality of services/accommodation offered. Recent studies have indicated that most people are going to tourist accommodations for the prime purpose of relaxation, although the quality of the Lake of the Woods fishery remains the primary tourism attraction in this area. Both angling and U.S. tourists are vital to the health of tourism in the Ontario Lake of the Woods region (Pannell *et al.* 2003).

The Ontario resident population will remain stable, since no major population changes are anticipated locally. Substantial growth in the resident winter fishery has occurred in recent years, especially in the North and Central sectors. The use of the fishery by non-resident property

owners has also increased, both in response to improvements in angling success rates and in proportion to cottage growth.

The angling fishery in Minnesota is expected to increase moderately as pressure and harvest are already nearing the target yields. Lake of the Woods should retain its status as one of the premier walleye/sauger lakes in North America.

Rainy Lake

Socio-Economic Infrastructure

History of Use

Accounts of early exploration refer to an extensive subsistence fishery by aboriginal inhabitants of this area. As early as the 1890s, residents and tourists began to make use of the Rainy Lake angling fishery for both food and recreation. Most commercial tourist establishments were built during the period from 1930 to 1960.

Commercial fishing for lake sturgeon and whitefish on Rainy Lake was an important source of income for local residents by 1890. The first large-scale commercial fishing operation was established at Bear Pass in 1898. With an increasing demand for walleye, gill nets came into use in 1909. By 1916, Rainy Lake had 62 licensed commercial fishers that operated in 25 designated fishing areas or lots. The level of commercial fishing activity on this lake declined substantially after the 1950s.

Local Communities and Population

There are approximately 26,600 people living year-round in the immediate area of Rainy Lake, with about 51% in Ontario and 49% in Minnesota (Table 3). Seventy-three percent of the population in Ontario and Minnesota live in municipalities, with the balance residing in unorganized territories.

The population density on both sides of the border has declined by about 4% since 1997. The population in Ontario has increased by 4%, while the population on the Minnesota side has decreased by 11%. A shift in population appears to have occurred from organized municipalities to unorganized areas during this same time period. On-reserve residents of five First Nations around Rainy Lake have increased by 28% since 1990, to an estimated 1,290 people in 2002.

Economy

The local economy of the Rainy Lake area is heavily dependent on forestry, agriculture, and tourism which provide the majority of job opportunities. The largest industrial employers are Abitibi-Consolidated Company of Canada in Ontario and Boise Cascade in Minnesota.

Table 3. Ontario—Minnesota population in the Rainy Lake area (2001 Census Canada; Department of Indian and Northern Development 2002; 2000 U.S. Census).

Ontario	
Organized Municipalities (2001)	Population
Fort Frances	8,315
Emo	1,331
Alberton	956
LaVallee Twp.	1,073
Sub Total	11,675
First Nations Communities (2002)	
Couchiching (16A)	541
Naicatchewenin (17A)	239
Nicickousemenecaning (26A)	120
Seine River (23A)	306
Stanjikoming (18C)	83
Sub Total	1,289
Unorganized Townships (2001)	
Rainy River	606
Sub Total	606
Ontario Total	13,570
Minnesota	
Municipalities (2000)	Population
International Falls	6,703
Island View	150
Littlefork	680
Ranier	188
Sub Total	7,721
Unorganized Territories (2000)	
Northwest Koochiching	541
Northwest St. Louis	306
Rainy Lake	4,469
Sub Total	5,316
Minnesota Total	13,037
Combined Ontario and Minnesota Total	26,607

Angling Effort

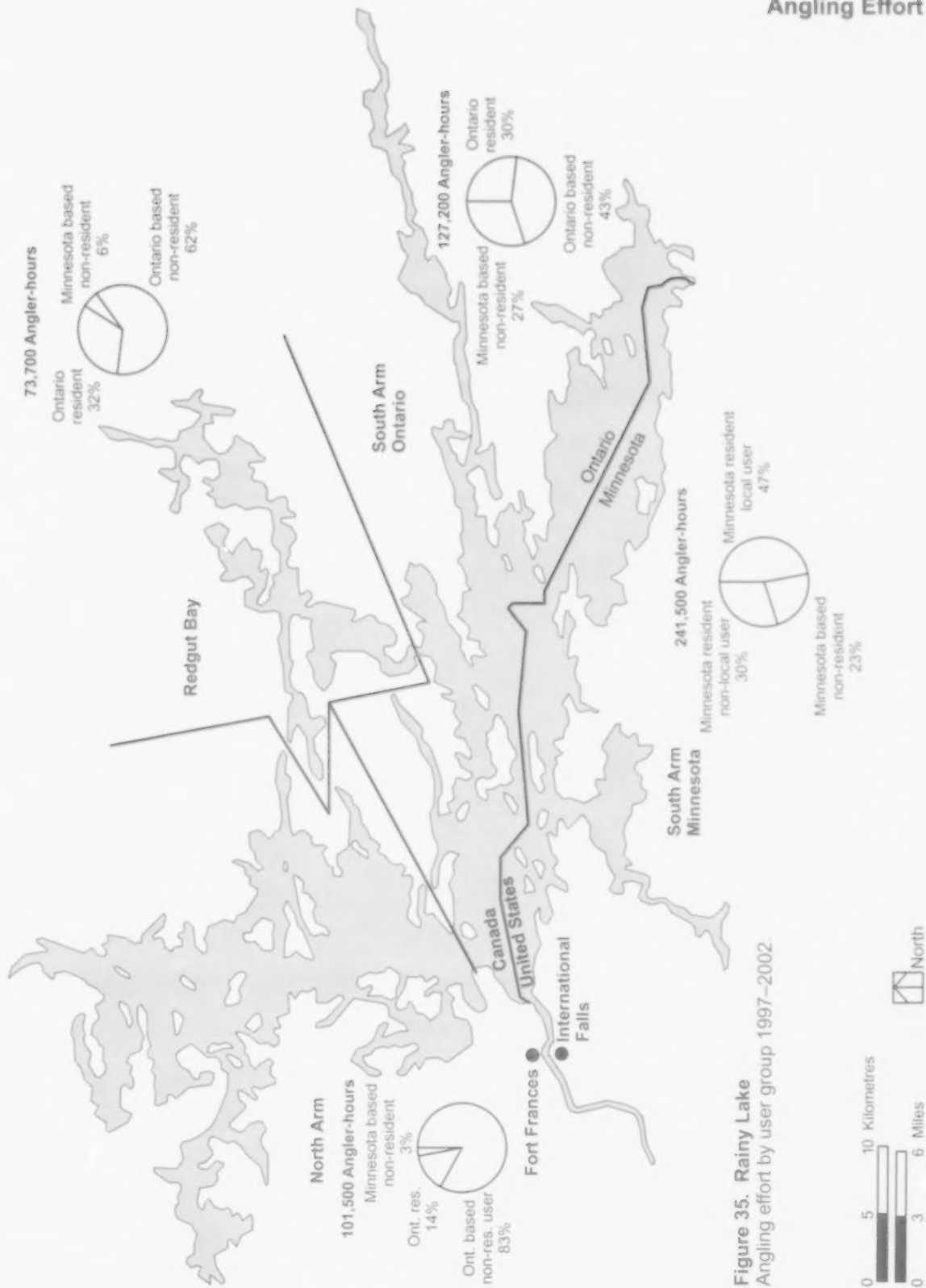


Figure 35. Rainy Lake
Angling effort by user group 1997-2002.

Fishery User Profiles

First Nations

The domestic (subsistence) harvest of fish is an important food source, as well as a long-standing tradition, for people living in five First Nations communities adjacent to Rainy Lake, Ontario. This harvest, estimated at 15,800 kg (34,700 lbs) annually for on-reserve residents (1990), is comprised primarily of walleye (30%), northern pike (30%), and whitefish (30%), while bass and crappie make up the remaining 10%.

Commercial Fishers

There were four commercial fishing operations on six commercial fishing lots in Ontario waters of Rainy Lake in 2002. Whitefish, northern pike, walleye, and black crappie have been the main species in the commercial fishery since the 1920s. All have been managed by quotas since 1984. Fish are harvested in Ontario with gill nets and trap nets, with unlimited quotas available for coarse fish including suckers *Catostomus commersoni*, lake herring (cisco), bullheads, burbot *Lota lota*, and mooneye. The commercial harvest of walleye was reduced by 97% during 1986–2002 through government buy-outs and trades for individual species quotas. Lake whitefish comprised most of the harvest, representing 28,800 kg (63,300 lbs) or 60% of the total commercial catch in 2001. Northern pike were the second most important commercial fish species at 13,500 kg (29,700 lbs), or 28% of the total. Suckers, lake herring, crappie, yellow perch, burbot, walleye, and sauger comprised the remaining 12%. The reported commercial catch of all fish species, including coarse fish, averaged 51,400 kg (113,000 lbs)/yr, from 1997–2002, which was slightly higher than the previous average of 49,700 kg (109,400 lbs)/yr during 1990–96.

Commercial harvest of gamefish on the Minnesota side was gradually reduced by gear restrictions and then eliminated with a legislated buy-out in 1985. There remains one commercial fishing operation which uses gill nets to harvest a whitefish quota of 14,400 kg (31,600 lbs)/yr on the Minnesota side of the South Arm, southeast of Brule Narrows.

Resident Anglers

Ontario residents fish all Ontario sectors of Rainy Lake (Figure 35). Resident angling effort increased from 39,700 angler-hr/yr during 1983–1995 to an all-time high of 79,900 angler-hr/yr in 2001–02. Proportionately, the Ontario resident component of the fishery was highest in Redgut Bay at 32% of the total effort, followed by

the South Arm (30%) and the North Arm (14%) fisheries. Resident anglers contributed a greater portion of the total effort than in the past, largely as a result of both changes in non-resident angling restrictions in 1994 and 2000, as well as dramatic improvements in the walleye fishery. Ontario residents were responsible for approximately 26% of the total annual angling harvest from the Ontario portion of Rainy Lake in 2001–02, compared to 22% in 1994–95.

Minnesota residents contributed 77% of all angling effort on the Minnesota side of Rainy Lake from 1997 to 2001, which could be further partitioned by local residents (47%) and non-local users (30%).

Non-Resident/ Non-Local Resort Guests

There were 35 main base tourist accommodation operations on Rainy Lake in 2002: 21 in Ontario, and 14 in Minnesota. Nine of these operations were on the North Arm, 5 on Redgut Bay, 7 on the Ontario South Arm, and 14 on the Minnesota portion of the South Arm. At least two additional resorts located adjacent to Rainy Lake, used the Ontario fishery. Three Minnesota establishments operated during the winter, while only two Ontario operations are known to be open for winter clientele. No estimates of occupancy were available since 1990.

Sixty-five percent of anglers on the North Arm were resort/houseboat guests from the North Arm, while an additional 2% originated from Minnesota resorts in 2002. Forty-eight percent of the Redgut Bay angling fishery was comprised of guests staying at Ontario resorts, while only 3% were from Minnesota commercial establishments in 2001. Over this same period, 24% of Ontario South Arm anglers were guests at an Ontario resort or houseboat operation, while 19% were from a Minnesota commercial base of operation, including houseboats. Minnesota-based resort use in all Ontario basins of the lake had declined from previous levels, as a result of the non-resident angling restrictions which were introduced in Ontario waters in 1994. However, the 2001–02 creel survey indicated that effort from this group has again increased, following regulation changes in 2000.

The Minnesota South Arm tourist fishery was composed entirely of angler guests based in Minnesota.

Non-Resident Property Owners

This group comprised 16% (49,300 angler-hr) of the total estimated effort on the Ontario portion of Rainy Lake in 2001–02, as compared to 15% in

1994–95. Non-resident cottagers represented 18% of the angling effort on the Ontario South Arm, 17% on the North Arm and 14% on Redgut Bay.

Minnesota-Based Anglers

Creel surveys conducted on the Ontario portion of Rainy Lake in 2001–02 indicated that 14% of angling effort was by Minnesota-based non-residents, as compared to 11% in 1994–95. This represented a significant decline from the previous average of 44% that was observed between 1983 and 1986.

Minnesota-based non-resident anglers represented 3% of the fishing effort in the North Arm, 6% in the Redgut Bay fishery, and 27% in Ontario's South Arm during the 2001–02 survey (Figure 35). This group had previously contributed much higher levels of use, averaging 10% of the estimated effort on the North Arm fishery, 35% on Redgut Bay and 72% on Ontario's South Arm during 1982–1992.

Minnesota-based non-residents had previously accounted for 55% of the total annual walleye harvest during 1983–1986. However, this group was not permitted to harvest any walleye from the Ontario portion of Rainy Lake during 1994–1999. Regulations were changed in 2000 for all non-resident of Canada anglers, to allow limited harvest under a daily catch limit of one (1) walleye and four (4) in possession.

Future Demands on the Fishery

Commercial Fishing

The number of licensed fishers and the amount of fish harvested on the Ontario side of Rainy Lake has reached an equilibrium since 1997, after experiencing a steady decline over the previous decade. In 1986, OMNR began purchasing quotas and/or licenses on a "willing seller" basis. Commercial quotas for walleye were reduced by 97%, northern pike by 55%, crappie by 52%, lake whitefish by 8%, and sturgeon by 100% through this program between 1986–96. The management intent in Ontario was to reduce the commercial walleye quota to zero while maintaining a commercial fishing industry based on whitefish, northern pike, and crappie. Domestic consumption by First Nations residents is expected to increase with population, if current trends continue. No changes are anticipated, with regard to commercial fishing, on the Minnesota side.

Angling

Angling demand is expected to continue to increase on Rainy Lake, as on the other border

waters, with improvements in fishing quality for walleye, and the continued popularity of high-quality smallmouth bass and northern pike fisheries. An increase in demand of 22% on the Ontario portion of the lake was anticipated by the year 2000 based on observed population growth. This trend is likely to continue over the next decade.

Angling effort increased substantially over the last two decades on the Minnesota portion of the South Arm, but has recently levelled off. Angling effort is expected to remain stable in the immediate future.

Namakan Lake

Socio-Economic Infrastructure

History of Use

Commercial fishing on Namakan Lake began in 1916–17. Walleye, northern pike, lake whitefish, and lake herring (cisco) were the most important species in the commercial catch. Commercial fishing for walleye and northern pike was eliminated in Minnesota waters in 1946. Since the 1950s, two licensed commercial fishers were active on the Minnesota side of the lake where they fished for lake whitefish. Only one fisher remains today. Commercial fishing on the Ontario portion of the lake began in 1947 with one licensed fishery, and the addition of a sturgeon licence in 1959. Commercial harvest of walleye and northern pike was prohibited in 1971–73, due to mercury contamination of the fish. The fishery re-opened in 1974, but was then closed again from 1976–78. Since 1974, harvest of walleye and northern pike has been controlled by quotas. Quotas were established for lake whitefish, black crappie, and lake sturgeon in 1984.

Angling became popular on Namakan Lake in the late 1920s when Minnesota resorts on Kabetogama and Crane lakes became accessible by automobile.

Local Communities and Populations

There are only two year-round residences on the shores of Namakan Lake; one is an Ontario tourist operation and the other is a Voyageurs National Park establishment at Kettle Falls. There are, however, two areas of localized habitation near Namakan Lake in Minnesota, including the unorganized territories of northwest St. Louis County (306 people; 2000 U.S. Census) on Kabetogama Lake, and the small community of Crane Lake. In addition, there are 36 summer cabins on Namakan Lake, including one seasonal commercial fish/hunting/fur trapping residence near Bear River, Ontario. There are a total of 37 patent properties and one recreational Land Use Permit (LUP) camp site on the Ontario portion.

Economy

The economy of the area is totally dependent on the utilization of natural resources. Tourism and the forest products industry provide the majority of job opportunities. Twenty-four Minnesota tourist operations and two Ontario tourist operations rely on the Namakan Lake fishery.

Fishery User Profiles

First Nations

Since there are no First Nations communities located on the Ontario portion of Namakan Lake, no estimates of subsistence harvest were made. Lac La Croix First Nation, with 270 on-reserve residents in 2002, is located further upstream in Ontario with no direct road access to Namakan, except via the Flanders Road and the Namakan River. Although traditional use of Namakan Lake occurs, estimates of subsistence harvest were not available.

Commercial Fishers

There were two licensed commercial fishing operations on Namakan Lake during 1997–2002: one in Ontario, and one in Minnesota. The Minnesota commercial fishery licensed for lake whitefish has averaged only 1,400 kg (3,000 lbs)/yr since the 1950s. Ontario's licensed commercial fishery annually harvested walleye, northern pike, lake whitefish, and lake sturgeon below established quotas levels until the licence was eliminated in 2002. The last reported commercial catch of all fish species, including coarse fish (i.e. suckers, cisco, bullheads, burbot, and mooneye), was 4,000 kg (8,800 lbs) in 2001. Lake whitefish comprised 40% of the total commercial catch or 1,600 kg (3,500 lbs) in that year. Walleye were the second most important commercial fish species at 26% of the total, followed by suckers (24%), and northern pike (9%). No lake sturgeon were reported since 1999. The annual catch for all species averaged 6,500 kg (14,400 lbs)/yr from 1997–2002.

Anglers

The estimated angling effort in Ontario declined from 30,400 angler-hr in 1993 to 18,800 angler-hr in 1998. Minnesota-based non-residents contributed 64% of the effort, while Ontario-based non-resident resort guests (21%), non-resident property owners (11%) and Ontario residents (1%) made up the remainder (Figure 36). The majority of angling effort originated from Minnesota resorts (28%) and day-tripper/cottagers from Minnesota (37%). Approximately 52% of users accessed Namakan Lake from operations or public facilities on Kabetogama Lake, while the remainder originated from Crane Lake. Angler access by road to the Namakan River in Ontario was limited.

The tourist accommodation industry is concentrated at two locations. Seven of the 38 establishments located on Kabetogama Lake relied on the Namakan Lake fishery for a large part of their business. Seventeen resorts on Crane

Angling Effort

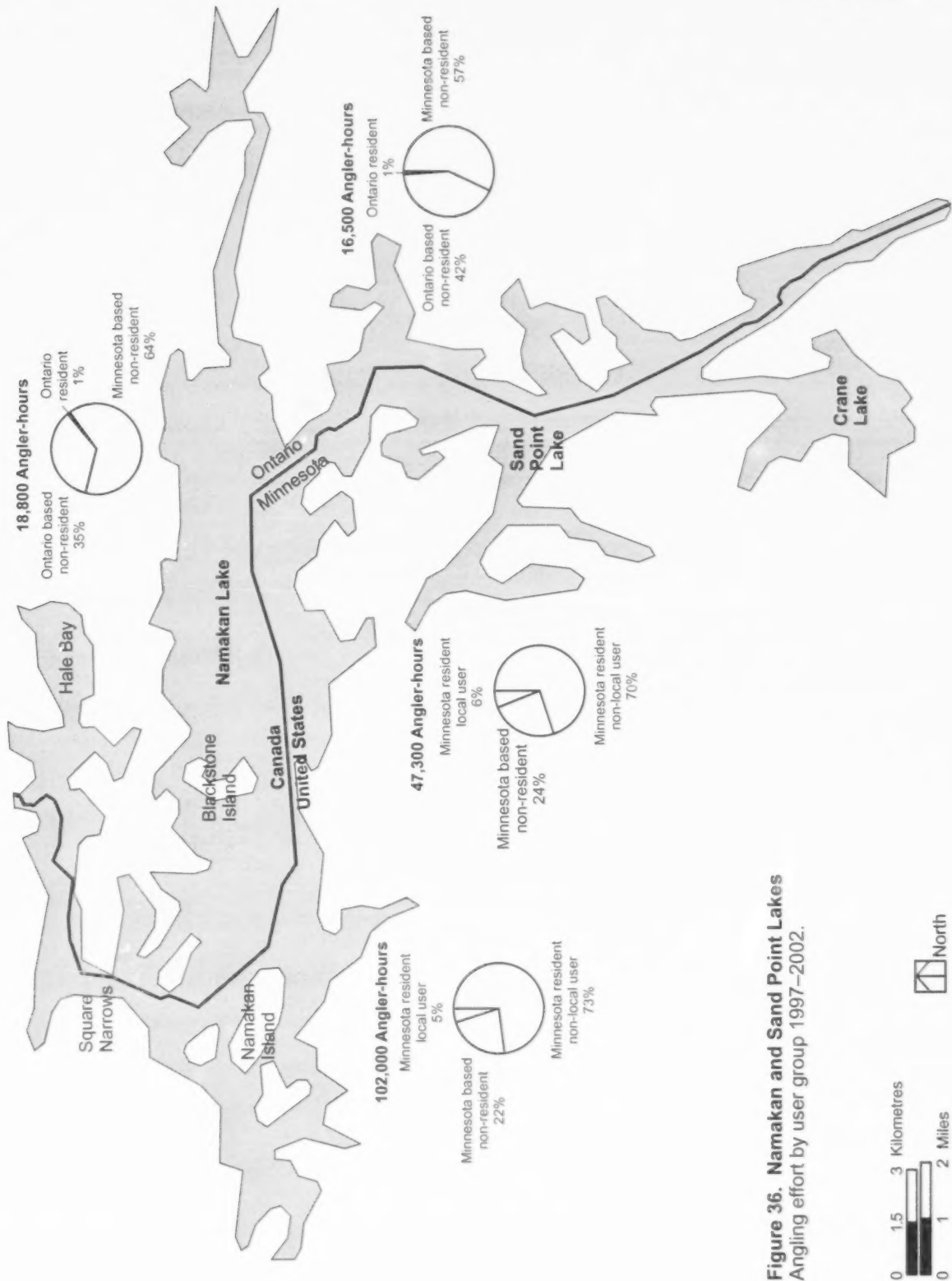


Figure 36. Namakan and Sand Point Lakes
Angling effort by user group 1997–2002.

Lake, Minnesota and one on Sand Point Lake, Ontario had clients who fished in Namakan Lake. One Ontario establishment is located on Namakan Lake itself. Of the 26 operations that relied on the Namakan Lake fishery, 24 were Minnesota-based and two were located in Ontario.

Future Demands on the Fishery

Commercial fishing for walleye and northern pike was phased out in Ontario waters in 2002. Opportunities for commercial harvesting of whitefish and coarse fish could be reviewed in the future, as stocks recover from decades of water level impacts (i.e. excessive overwinter drawdown). The one remaining licence in Minnesota waters of Namakan Lake will be eliminated when the current licensee is no longer involved in the fishery. The licence will not be transferred to another family member.

Voyageurs National Park estimated that park visitation will grow at a slow to moderate rate (2 to 4% per year) for the next 10 years. The Namakan Lake fishery will continue to be an important resource to anglers and to the tourism industry which relies upon it. Recent road access in Ontario may also provide residents with a greater diversity of angling opportunities.

Sand Point Lake

Socio-Economic Infrastructure

History of Use

Commercial fishing first began on the Ontario portion of Sand Point Lake during 1971–73, when the walleye and northern pike fishery on Namakan Lake was closed, due to mercury contamination. Black crappie comprised the majority of the harvest during this period, along with suckers and minor amounts of walleye and northern pike. The commercial fishery resumed in 1981 under an experimental permit to trap net black crappie, suckers, lake sturgeon, whitefish and lake herring (cisco). An additional experimental fishing permit was issued to harvest whitefish from Sand Point Lake in 1982. A permanent commercial fishing licence was issued in 1983, with harvest quotas for black crappie, whitefish, sturgeon, and small incidental quotas for walleye and northern pike. Since 1990, Ontario commercial harvests have only approached quota levels for lake sturgeon. This fishery along with the one on Namakan Lake were eliminated in 2002 by government purchase. Angling became popular on Sand Point Lake in the late 1920s, with most effort originating from road accessible resorts on Kabetogama and Crane lakes in Minnesota.

Local Communities and Populations

There are a few seasonal residences on the shores of Sand Point Lake, including: a tourist operation, store, Canada Customs and Immigration point of entry, and a Boy Scout camp in Ontario. In addition, there are 38 private cottages located on the Ontario portion of the lake. Within Voyageurs National Park in Minnesota, there are three privately developed tracts, 9 use and occupancy tracts, 24 campsites, and 6 houseboat mooring sites. The unorganized territories of Northwest St. Louis County on Kabetogama Lake and the small community of Crane Lake are located adjacent to Sand Point Lake in Minnesota.

Economy

The economy of the area is totally dependent on the utilization of natural resources. Tourism and the forest products industry provide the majority of job opportunities. Twenty-four tourist operations in Minnesota and two in Ontario use the Sand Point Lake fishery.

Fishery User Profiles

First Nations

There are no First Nations communities located on the Ontario portion of Sand Point Lake. Lac La Croix First Nation, with 270 on-reserve residents in 2002, is located further upstream in Ontario with no direct road access to Sand Point Lake. Although traditional use of Sand Point Lake occurs, estimates of subsistence harvest were not available.

Commercial Fishers

There was one licensed commercial fishery on Sand Point Lake in Ontario until 2002 when it was eliminated by government purchase. This fishery accounted for all crappie, whitefish and lake sturgeon harvest from 1997–2002 but only about 1% of the total walleye and pike harvest during this period. The last reported commercial catch of all fish species, including coarse fish, was 700 kg (1,600 lbs) in 2001. Lake whitefish comprised 88% of the total commercial catch or 600 kg (1,400 lbs) while walleye (5%), northern pike (4%) and suckers (3%) represented the remainder. No lake sturgeon have been harvested since 1999. The annual reported catch for all species averaged 800 kg (1,700 lbs)/yr during 1997–2002.

Anglers

Angling effort in Ontario waters of Sand Point Lake declined from 26,200 angler-hr in 1993 to 16,500 angler-hours in 1998. Minnesota-based non-residents accounted for 57% of the total estimated effort while Ontario-based non-resident resort guests (23%), Ontario non-resident property owners (19%), and Ontario residents (1%) made up the remainder (Figure 36). The majority of angling effort originated from Minnesota resorts (26%) and day-trippers/cottagers from Minnesota (31%).

Most users accessed Sand Point Lake from resorts or public facilities on Crane Lake, while the remainder originated from Kabetogama and Namakan lakes. Seven of the 38 establishments located on Kabetogama Lake relied on the Sand Point Lake fishery for a small part of their business. Seventeen resorts on Crane Lake and one on Namakan Lake had clients who fished on Sand Point Lake. One Ontario establishment is located on Sand Point Lake itself. Of the 26 operations which relied upon the Sand Point Lake fishery, 24 were Minnesota-based while two were located in Ontario.

Future Demands on the Fishery

Commercial fishing for walleye and northern pike was phased out in the Ontario portion of Sand Point Lake in 2002. Opportunities for commercial harvesting of whitefish and coarse fish may exist in the future, as stocks recover from decades of water level impacts (i.e. excessive overwinter drawdown).

Voyageurs National Park estimated that park visitation will grow at a slow to moderate rate (2 to 4% per year) for the next 10 years. The Sand Point Lake fishery will continue to be an important resource to anglers and to the local tourist industry. Recent road access to Namakan Lake in Ontario may also provide some new fishing opportunities on Sand Point Lake for resident users.

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Appendix 1.

Potential yield estimates (kg/yr) by species and basin of Lake of the Woods/Rainy River, as determined from the Morphoedaphic Index (MEI). The percentage of the total potential fish yield for each species is shown in brackets. Partitioning differs between lakes and jurisdictions based on differences in the available biomass as identified by assessment netting.

Fish Species	Ontario North Sector (1)	Ontario Central Sector (2)	Ontario Whitefish Bay (3)	Ontario Sabaskong Bay (4)	Ontario South Sector ² (5)	Ontario South Sector (6)	Minnesota Big Traverse ²
Walleye	25,500 (23)	39,300 (23)	11,600 (20)	20,600 (23)	64,000 (21)	35,300 (21)	204,500 (33)
Northern Pike	27,800 (25)	34,200 (20)	13,400 (23)	22,400 (25)	61,000 (20)	33,600 (20)	122,200 (20)
Smallmouth/ Largemouth Bass	18,900 (17)	29,100 (17)	9,900 (17)	12,500 (14)	24,400 (8)	20,700 (12)	30,500 (5)
Sauger	6,700 (6)	12,000 (7)	n/a	6,300 (7)	21,400 (7)	11,800 (7)	113,600 (18)
Yellow Perch	4,500 (4)	5,100 (3)	1,500 (2)	2,700 (3)	15,300 (5)	8,400 (5)	30,500 (5)
Black Crappie	3,300 (3)	5,100 (3)	1,700 (3)	22,700 (25)	15,300 (5)	8,400 (5)	n/a
Lake Whitefish	22,200 (20)	5,100 (3)	5,800 (10)	n/a	n/a	n/a	n/a
Lake Trout	1,100 (1)	n/a	11,600 (20)	n/a	n/a	n/a	n/a
Lake Sturgeon ¹	n/a	n/a	n/a	n/a	3,000 (1)	n/a	5,300 (1)
Total Potential Fish Yield	111,000	171,000	58,100	89,600	305,000	167,700	622,700

¹ Lake sturgeon yields calculated at 0.04 kg/ha/yr and surface area less than 12.2 metres deep.

² Includes estimates for Rainy River.

Appendix 2.

Potential yield estimates (kg/yr) by species and basin of Rainy Lake, as determined from the Morphoedaphic Index (MEI). The percentage of the total potential fish yield for each species is shown in brackets.

Fish Species	North Arm	Redgut Bay	South Arm Ontario	South Arm Minnesota	Total
Walleye	33,800 (30%)	7,600 (32%)	23,700 (32%)	19,200 (32%)	84,300 (31%)
Yellow Perch	2,300 (2%)	0	0	0	2,300 (1%)
Northern Pike	28,200 (25%)	4,700 (20%)	18,500 (25%)	15,000 (25%)	66,400 (24%)
Smallmouth Bass	5,600 (5%)	1,000 (4%)	6,000 (8%)	4,800 (8%)	17,400 (7%)
Black Crappie	15,800 (14%)	4,700 (20%)	8,100 (11%)	6,600 (11%)	35,200 (13%)
Whitefish	27,000 (24%)	5,700 (24%)	17,800 (24%)	14,400 (24%)	64,900 (24%)
Subtotal	112,700 (100%)	23,700 (100%)	74,100 (100%)	60,000 (100%)	270,500 (100%)
Lake Sturgeon ¹	900	200	700	600	2,500
Total Potential Fish Yield	113,600	23,900	74,800	60,600	272,900

¹ Lake sturgeon yields calculated at 0.04 kg/ha/yr and surface area less than 12.2 metres deep.

Appendix 3.

Potential yield estimates by species (kg/yr) on Namakan Lake, as determined from the Morphoedaphic Index (MEI). The percentage of the total potential fish yield for each species is shown in brackets.

Fish Species	Ontario	Minnesota	Total
Walleye	4,100 (32%)	4,000 (32%)	8,100 (32%)
Northern Pike	3,200 (25%)	3,100 (25%)	6,300 (25%)
Smallmouth Bass	2,000 (16%)	2,000 (16%)	4,000 (16%)
Black Crappie	400 (3%)	400 (3%)	800 (3%)
Whitefish	3,100 (24%)	3,000 (24%)	6,100 (24%)
Subtotal	12,800 (100%)	12,500 (100%)	25,300 (100%)
Lake Sturgeon ¹	100	100	200
Total Potential Fish Yield	12,900	12,600	25,500

¹ Lake sturgeon yields calculated at 0.04 kg/ha/yr and surface area less than 12.2 metres deep.

Appendix 4.

Potential yield estimates by species (kg/yr) on Sand Point Lake, as determined from the Morphoedaphic Index (MEI). The percentage of the total potential fish yield for each species is shown in brackets.

Fish Species	Ontario	Minnesota	Total
Walleye	1,400 (32%)	2,000 (32%)	3,400 (32%)
Northern Pike	1,100 (25%)	1,500 (25%)	2,600 (25%)
Smallmouth Bass	600 (13%)	800 (13%)	1,400 (13%)
Black Crappie	300 (6%)	400 (6%)	700 (6%)
Whitefish	1,000 (24%)	1,500 (24%)	2,500 (24%)
Subtotal	4,400 (100%)	6,200 (100%)	10,600 (100%)
Lake Sturgeon ¹	40	50	90
Total Potential Fish Yield	4,440	6,250	10,690

¹ Lake sturgeon yields calculated at 0.04 kg/ha/yr and surface area less than 12.2 metres deep.

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